Food System Analysis and the Development of a System Dynamics Approach to Improve Food Security for a Vulnerable Community in the Breede River Region, Western Cape Province, South Africa

by

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I. Declaration

By submitting this thesis electronically, I declare that the entirety of the work contained therein is my own, original work, that I am the sole author thereof (save to the extent explicitly otherwise stated), that reproduction and publication thereof by Stellenbosch University will not infringe any third party rights and that I have not previously in its entirety or in part submitted it for obtaining any qualification.

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II. Abstract

The current food system is failing to effectively serve the urban poor. The modernisation and globalisation of the food system solves one set of problems, regarding food security, but at the same time it results in the creation of other complex challenges. Technically the food system ensures adequate food availability on a macro scale, but the structure of the system contributes to the creation of food deserts. Food deserts are areas in which there is a lack of food retail outlets where affordable, nutritious food is available. Communities living in these areas usually struggle to obtain a nutritious diet and the residents are characterised as poverty-stricken and of a poor nutritional status.

The aim of this research is to support local authorities in the management and strategic planning of community food security. The research was conducted in Avian Park, a low-income community in the Breede Valley of the Western Cape, South Africa. The food retail environment of Avian Park was investigated to determine the availability and accessibility of food in the community. Furthermore, a system dynamics model was developed to identify those areas in the food system which need attention, in order to achieve greater food security.

In addition strategies are suggested to improve community food security; specifically for Avian Park. These research outcomes, however, also serve as a general guideline for managing food security in low-income communities more effectively.

III. Opsomming

Die huidige voedsel sisteem slaag nie daarin om arm mense in stede effektief te dien nie. Die ontwikkeling en globalisering van die voedsel sisteem los een stel probleme rondom voedselsekerheid op, maar skep terselfdetyd ander komplekse uitdagings. Tegnies verseker die voedsel sisteem die beskikbaarheid van genoegsame voedsel op 'n makro skaal, maar die struktuur van die sisteem dra by tot die ontwikkeling van "food deserts." "Food deserts" is areas waar daar 'n tekort aan voedsel kleinhandel afsetpunte is waar daar bekostigbare, voedsame kos beskikbaar is. Gemeenskappe wat in hieride areas leef sukkel gewoonlik om 'n voedsame dieet te bekom en die inwoners word geken aan armoede en 'n ongewenste voedingstatus.

Die doel van hierdie navorsing is om plaaslike owerhede te ondersteun om gemeenskap voedselsekerheid meer efektief te bestuur. Die navorsing was in Avian Park, 'n lae-inkomste gemeensakp in die Breede Vallei van die Wes-Kaap, Suid-Afrika uitgevoer. Die voedsel kleinhandel omgewing van Avian Park is ondersoek om die voedsel beskikbaarheid en toegangklikheid te bepaal. Verder is 'n "system dynamics" model ontwikkel om die areas in die voeldsel sisteem wat aandag verg, ten einde voedselsekuriteit te bekom, te identifiseer.

Ten slotte word daar strategieë voorgestel om gemeenskap voeldselsekuriteit in Avian Park te verbeter. Hierdie navorsingsuitkomste dien egter ook as algemene riglyne om lae inkomste gemeenskappe se voedselsekerheid meer effektief te bestuur.

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To Jesus, my rock
Holy Spirit, my helper
God the King
all the glory is Yours

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1. Introduction

1.1 Background

Stellenbosch University's Overarching Strategic Plan (OSP) was introduced in 2008, as a framework to maintain and extend the university's leadership position as an institution of excellence. Part of the vision is to mobilise the university as a key role player in the effort to solve the social and environmental problems in Africa and specifically South Africa. One of the internal objectives of this strategic plan is for the university to transform into an institution that is more relevant and active in society.

The refined strategic objectives of the OSP fit into the key national and international developmental themes such as; poverty eradication, the promotion of human security, the promotion of human dignity and democracy, as well as the maintenance of environmental sustainability (1). The Food Security Initiative (FSI) is one of the approved OSP projects and "*contributes to the emergence of a resilient, sustainable food system for Southern Africa, by reconceptualising the food security challenge, and creating new models of practice in the food system, through the integration of findings from in depth research on key issues in the food value chain, collaboration across disciplinary boundaries, capacity building and systematic impact assessment"* (2). Research projects within the FSI have been developed across different faculties and academic departments, including the Department of Industrial Engineering.

This research initiative is part of a broader multidisciplinary project conducted by the Division of Human Nutrition in two communities (Avian Park and Zweletemba) in the Breede Valley of the Western Cape, South Africa. More specifically, this research will only focus on Avian Park, which is considered to be a good example of a lower socio-economic coloured community, in the South African context. The community is faced with typical challenges like poverty, illiteracy, unemployment, food insecurity and violence. The investigations in Phase one of the project will form the basis for further in-depth research and a long term commitment to the design and implementation of community food security strategies which could contribute to the resilience of the local food system and the healthy growth of children.

1.2 Problem statement

Low-income communities[1] or households living in informal settlements often struggle to obtain a nutritious diet. These marginalised communities consume mainly energy-dense, nutritionally inferior foods and eat very little fruit and vegetables (4,5,6). This issue is mostly dealt with by treating the symptoms, through the provision of grants and food aid (e.g. school feeding schemes) (7), but there are numerous other factors that need attention in order to ensure sustainable food security. The food security status of a community is intricately dependent on the community's food system (8).

Studies have shown that there is a connection between the ability to meet one's dietary recommendations and one's local food environment. The availability and accessibility of food in retail outlets will influence the dietary choices and therefore the food security status of a community (9,10,11,12). This is particularly true for non-agricultural communities, where access to retail outlets, that sell a variety of affordable, nutritious food, is a prerequisite for adopting a balanced diet (13).

The present food system is failing to adequately serve the urban poor (14). There is a market failure in both the formal and informal retail sector of the food system. The fact that the more food insecure a household is, the more likely it is to depend on a less formal means of securing food, suggests that there is some sort of market failure in the modern food system. There are also structural problems in the formal and informal markets that exist in the current modern food system, which contribute to the prevalence of food insecurity in cities and communities. More attention to research, development planning, and policy making, must be devoted to the urban food system, as it is a significant contributor to the health, welfare and local economy of a community (14,15). If community food systems are developed systematically they can strengthen communities and regions, alleviate problems like poverty, inequity, unemployment as well as environmental sustainability issues and ultimately ensure food security (16).

[1] "Community" is defined as a group of interacting people living in a common neighbourhood (3).

1.3 Aim

The aim of this project is to support local authorities in their management and strategic planning of community food security in Avian Park.

This is done by providing an understanding of the structure of the food system and to identify possible problem areas that could be managed more effectively, to ensure greater food security for the community. Strategies, specifically devised for Avian Park, are suggested to improve the food security in this community. These research outcomes also serve as general guidelines for managing food security of urban low-income communities more effectively.

1.4 Overview of the research design

The research design is aimed at meeting the following three research objectives:

i. to investigate the modernised food system and to determine how it contributes to the food security status of low-income communities;
ii. to gain an understanding of the current status of the local food system in Avian Park, focusing on the local food distribution system (concentrating on food availability and accessibility) and
iii. to provide technical information that local authorities could use in management and strategic planning, to ensure community food security.

A systematic literature review was done to investigate the food system and to determine how it contributes to the food security status of low-income communities (objective (i)). The search for literature is divided into two phases. The first phase consists of an introductory chapter that includes the definition and concept of food security, the global and national food security situation and a critical overview of food security studies done in South Africa (Chapter 2).

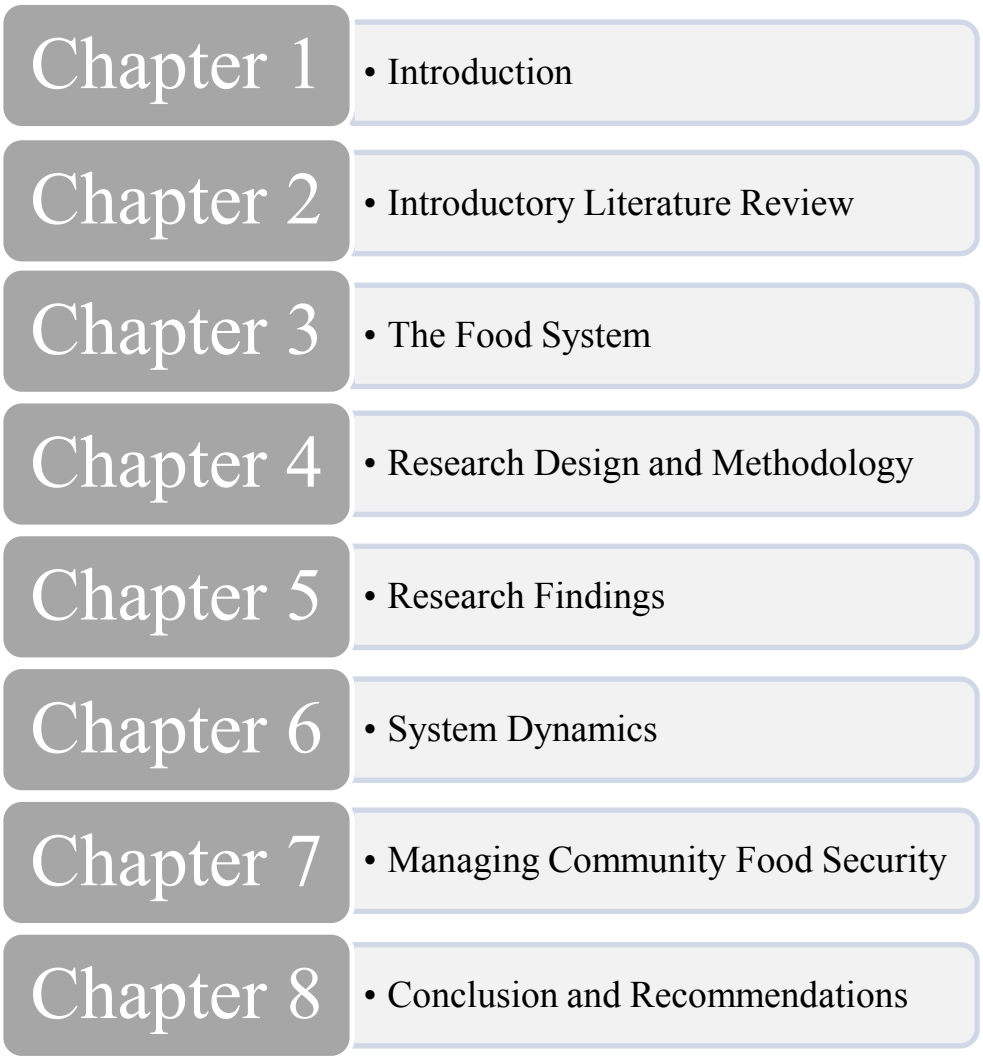
The second phase includes a review of literature on the modernised food system and enables the determination of the specific challenges that the system creates, in terms of community food security (Chapter 3). A comprehensive account of the influence of the current global situation on local communities, and literature on the development and globalisation of the food system, is included in the review. Studies show that in the modernised food system, the food retail environment has a direct influence on the food security status of a community. The formal and informal food retail sector of South Africa is therefore investigated. This is followed by an

overview of international and national studies, done to assess the food retail environment and to determine to what extent it contributes to the food security status of low-income communities. A theoretical framework is thus created for the systematic research approach, (Figure 6, p.34), used to reach objective (ii).

The above mentioned research approach is applied to the food system of Avian Park, to build an understanding of the local food retail sector. Quantitative data on food prices in the food retail sector is collected, analysed and supported by semi-structured interviews and Focus Groups Discussions (FGD), to determine the availability and accessibility of food in the community (objective (ii)).

The research findings are analysed to provide information for local authorities, to support them in management and strategic planning, which could ultimately ensure community food security in Avian Park. The findings are further used to develop a system dynamics (SD) model to investigate the structural constraints in the food system, in terms of food availability and accessibility. The model is run with different sets of inputs to test different scenarios. The results illustrate the behaviour of the system and highlights areas of potential intervention for local authorities to manage food security more effectively (objective (iii)). Chapter 5 provides a detailed description of the empirical research design and methodology.

1.5 Thesis outline



Chapter 1: Introduction

Chapter 1 presents the research **background** and **problem statement** which provide the context in which the study was conducted. This is followed by the **aim** of the study and an **overview of the research design**. The research design is developed to meet the listed **research objectives**.

Chapter 2: Introductory Literature Review

Chapter 2 provides an **overview of food security**. This chapter forms the **foundation** on which the rest of the study is built.

Chapter 3: The Food System

Chapter 3 serves as a **systematic literature review**. The food system is investigated to determine how it contributes to the food security status of low-income communities. The findings are used to develop the research design.

Chapter 4: Research Design and Methodology

Chapter 4 describes the **research design and methodology** used to investigate the food system of Avian Park.

Chapter 5: Research Findings

Chapter 5 presents and discusses the **research findings** to provide an in depth **understanding of the food system of Avian Park**. This information is used to build a system dynamics model presented in the next chapter.

Chapter 6: System Dynamics

Chapter 6 first gives an **overview of system dynamics**. This is followed by the presentation and workings of the system dynamics **model** developed for Avian Park.

Chapter 7: Managing Community Food Security

Chapter 7 uses the findings of the previous chapter to outline the areas in the food system of Avian Park that needs improvement to ensure greater community food security. The aspect of **managing community food** security is addressed.

Chapter 8: Conclusion and Recommendations

Chapter 8 offers a **conclusion** and **recommendations** for future research.

2. Introductory Literature Review

2.1 Introduction

The aim of the introductory literature review is to introduce food security as a research topic, as it is not a familiar field within Industrial Engineering. The definition of food security is first given (Section 2.2) and the different dimensions of food security are then discussed (Section 2.3). This is followed by a global perspective on food security (Section 2.4) after which, the food security situation in South Africa is investigated (Section 2.5).

2.2 Defining food security

Food security is a concept that only originated in the 1970s (17). The intricate combination of technical, political, economic and social issues involved in food security resulted in the origin of more than 200 definitions in published writings up to 2003 (18). A brief overview of the evolution of the definition is given, to highlight the trends in official stances and therefore policies that have been made on the subject.

The initial concern in food security was simply to ensure that food was available and that prices were kept stable on an international and national level. The focus was primarily on agricultural practices, so as to guarantee a sustainable food supply and steady food prices. This idea is reflected in the definition of food security as stipulated in the 1974 World Food Summit:

"*availability at all times of adequate world food supplies of basic foodstuffs to sustain a steady expansion of food consumption and to offset fluctuations in production and prices*" (19).

After the green revolution in the 1980s, it was recognised that technical success in the food production and processing industries alone did not guarantee food security. The complexity of the concept of food security, which will be presented in section 2.3, p.8 explains why food emergencies and famines cannot linearly be traced back to food production issues alone. Physical and economical access to food was identified as the key in defining food security (20). As the global food security situation degenerated, it became a priority in research, development and poverty alleviation strategies as well as policy development. The definition expanded further by including the importance of nutrition and food preferences amongst consumers (17). The current

accepted definition emphasizes the fact that sustainable access to food is needed to ensure food security and states that:

"Food security exists when all people, at all times, have physical, social and economic access to sufficient, safe and nutritious food which meets their dietary needs and food preferences for an active and healthy life" (21).

2.3 Conceptualising food security

Food insecurity is a multidimensional phenomenon. It can manifest through a lack of availability, accessibility or the inadequate utilisation of food (21,22). The conceptual framework, (Figure 1) seen below, illustrates the three dimensions of food security, the interaction between them and the factors affecting these dimensions.

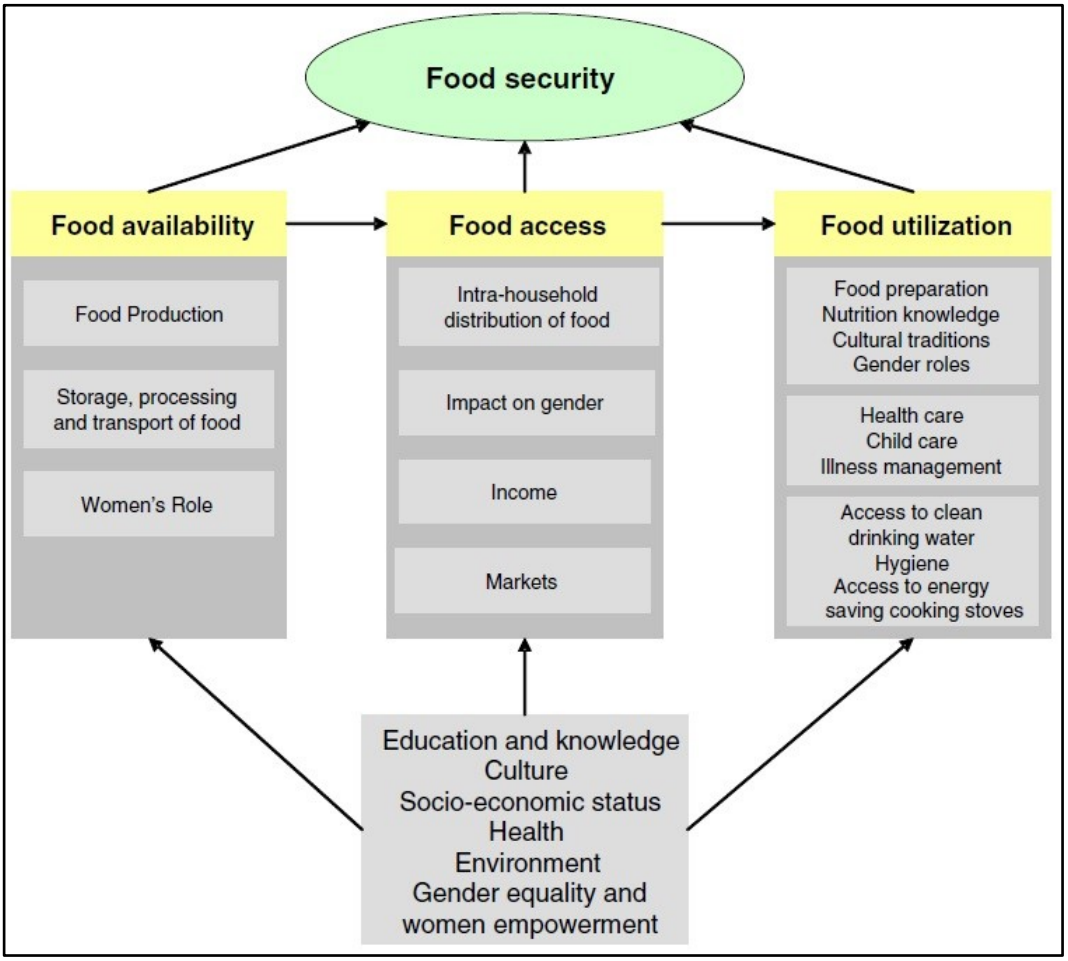


Figure 1 Conceptual framework of food security (23)

2.3.1 Food availability

Food availability refers to the physical existence of food, either through self-production or food provided by the market (20). Factors like storage, transportation and distribution of food as well as the women's role in the house, are essential for ensuring food availability (23). This dimension of food security also includes food aid where necessary (24). Agriculture plays an important role at all levels and dimensions of food security, but food security does not exclusively depend on an adequate supply of food. Food availability is a necessary, but not sufficient, condition for achieving food security.

2.3.2 Food access

Access to food depends on both physical and economic factors. The condition of the infrastructure, such as roads, transportation and market outlets will determine the physical accessibility of food. The location of supermarkets is also a key determinant of food access (25). The economic access to food depends on the purchasing power of a household, which is determined by the existing food prices, local prices relative to external prices and household income levels (23,25,26). The basic idea behind this dimension of food security is that people should have access to nutritious, culturally acceptable food (24).

2.3.3 Food utilisation

If sufficient and nutritious food is both available and accessible, then the use of food will depend on what the household decides to purchase and how it is prepared and consumed (20). Nutritional knowledge, education, health care and access to clean water are some of the factors that influence the utilisation of food (23). Food utilisation also refers to the quality and quantity of the food consumed; the food must be sufficient to meet the basic dietary energy and nutrient requirements of a person (26).

The conceptual framework seen in Figure 1 represents the many indicators that influence food security. These need to be taken into account when measuring or monitoring food security. Education and knowledge, culture, socio-economic status, health, the environment and gender equality are all underlying factors that indirectly contribute to food security (23).

2.4 Global food security

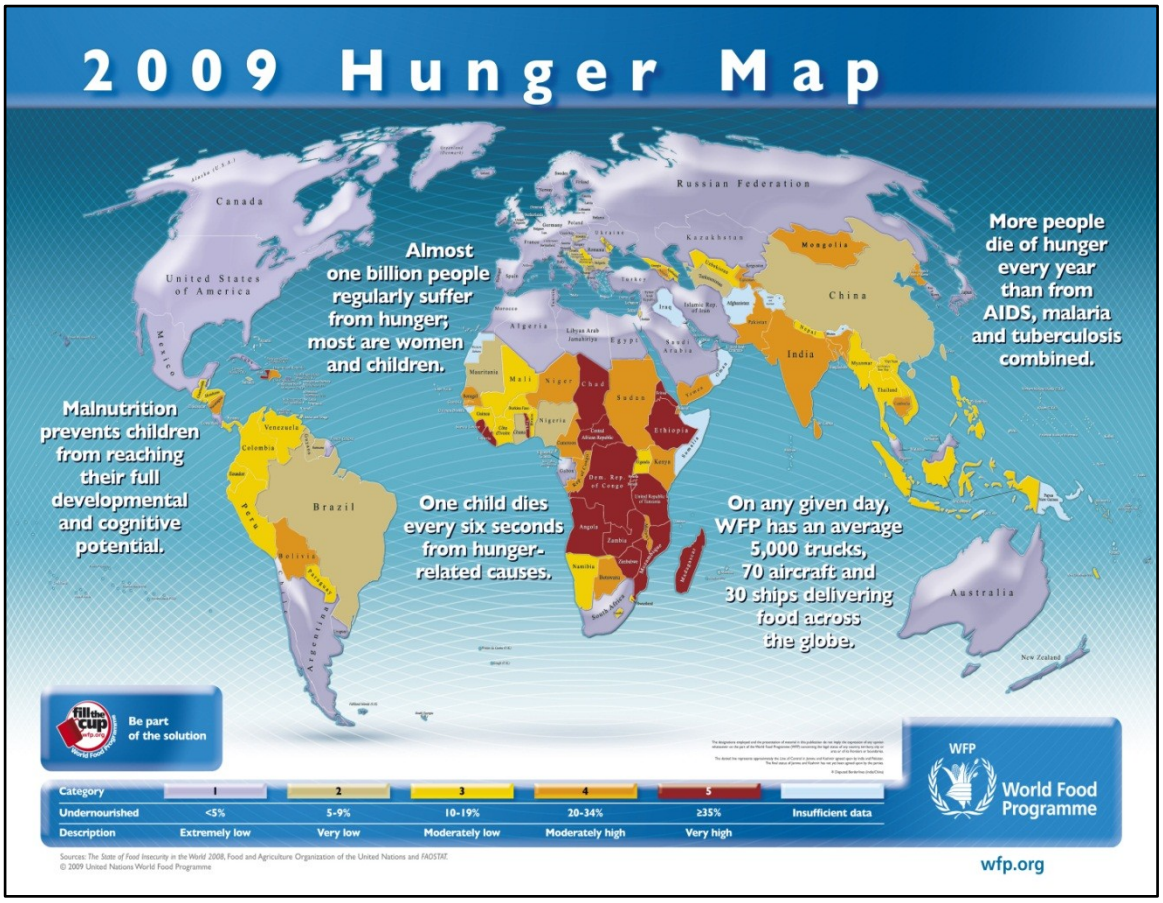
Addressing global food security can be reduced to the challenge of providing nutritious, safe and affordable food for a future global population of over 9 billion people. However, this issue cannot be approached in isolation. Achieving food security is linked to poverty eradication, environmental sustainability, agricultural research and social development.

The global food security situation is discussed by highlighting four main issues concerning food insecurity:

- Food security remains a major global concern (section 2.4.1).
- Global food security is vulnerable to agricultural and economic shocks (section 2.4.2).
- Investment in agriculture remains a critical element to ensure sustainable long-term food security (section 2.4.3).
- The drivers of food insecurity have become all the more complex (section 2.4.4).

2.4.1 Food insecurity remains a major global concern

The number of undernourished people in the world still remains unacceptably high at close to one billion in 2010 (27). This is documented as the second highest number of undernourished people since the FAO's record keeping began in 1961 (28). The 2009 Hunger Map, created by the World Food Program (Figure 2), provides a summary of the global food security situation.



Category	1	2	3	4	5	6
Undernourished	<5%	5-9%	10-19%	20-34%	>35%	Insufficient Data
Description	Extremely Low	Very Low	Moderately Low	Moderately High	Very High	Insufficient Data

Figure 2 Global hunger map (29)

The highest prevalence of under-nourishment[2] is found in sub-Saharan Africa, where 30% of the total population was estimated to be under-nourished between 2005 and 2007 (28). Other regions most severely affected by hunger and poor nutrition are Asia and the Pacific, especially India, and some parts of Latin America. The underlying issue of global food insecurity is mentioned in Box 1.

[2]The FAO defines under-nourishment as "*food intake that is continuously insufficient to meet dietary energy requirements"* (30).

If the Millennium Development Goal (MDG) of reducing the proportion of people who suffer from hunger by half is reached in 2015, it is estimated that up to 600 million people in developing countries would still be under-nourished (27).

Box 1: Causes of global food insecurity

There is a misconception that famine[1] is the biggest and most urgent issue with regard to hunger and food insecurity in the world. This idea is advanced by the media coverage and attention given to conflicts and food crises. Famine is not the main cause of hunger and malnutrition; 90% of food insecurity in the world is as a result of structural deficits within individual countries, and not due to food shortage because of natural or human calamities. Up to 200 000 people starve to death annually during famines, but 40 million people die globally each year from hunger-related causes (31).

1. Famine: Temporary and localized severe food shortage, caused by drought or conflict.

2.4.2 Global food security vulnerability

The events in the world economy and the global agricultural markets over the past few years have exposed the vulnerability of global food security. Economic and food price crises decreased the purchasing power of households, thus reducing food access and in turn, food security (28). A summary of these global events, and the food security trends over the past 50 years, are given below to illustrate the strong relationship between the two.

The price of food commodities declined remarkably from the 1960's to the late 1990's because of growth and development in the agricultural sector. During this time, there was a continuous decline in the number of undernourished people in the world up to 1997 where it reached the

lowest recorded level of just under 800 million. Between 2003 and 2006, there were signs of an increase in food prices. It was estimated that from 2004 to 2006, the number of people worldwide, who suffered from hunger or under-nourishment, grew to 873 million (32). The economic crisis which took place from 2007 to 2009, also led to a food price crisis. This caused the number of undernourished people in the world to peak at more than one billion in 2009. The effect could especially be seen in Africa where under-nourishment, between 2007 and 2008, increased by 8%. Prices declined slightly in 2008, but began to rise again in 2010. By 2010, the world economy had recovered and economic growth rates began to increase again. After this economic shock, the Food and Agriculture Organisation (FAO) projected the number of undernourished people in the world to be 925 million (27,28).

Figure 3 depicts the trend in the number of undernourished people in the world from 1967-71 to 2010, as agriculture developed and the economy fluctuated.

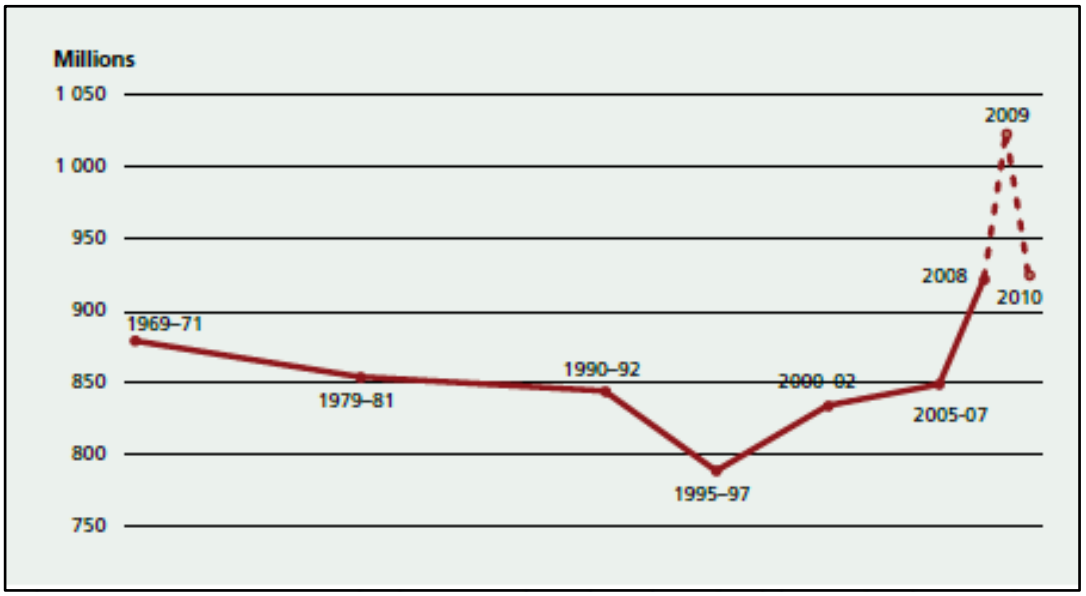


Figure 3 Global trends in under-nourishment (28)

According to the FAO, volatile food prices are likely to continue (27).

2.4.3 Agricultural investment

Despite fluctuations in the agricultural market, food production over the last decade has increased in all regions, except Western Europe, Japan and Oceania (27).

The agricultural system is currently producing enough food to meet the world food demand (28,31). Thus, on average, taking the global food production into consideration, every person should have access to 2720 kcal per day, which is more than the minimum average daily energy requirement (21), according to the United States Department of Agriculture (USDA).

The modernisation of the agricultural sector, however, raises some concerns in terms of the impact it has on the environment and on small, emerging farmers. The commercialisation of agriculture and the transformation of the production methods are contributing to an increasing loss of biodiversity and degradation of soil quality. Soil degradation leads to the abandoning of between 5-12 million hectares of land every year (33), resulting in an inevitable decrease in production (34). With regard to small farmers; they are marginalised and have difficulties in contributing, in a meaningful and effective way, to the food system. Small farmers need to enter the dynamic food system to escape from poverty, but the mordernised agricultural sector makes it impossible for them to be competitive in terms of quality, prices and volume of produce (35). Research (36) supports the idea that there is an urgent need to link small farmers with the global market, as they could be part of the solution to global food insecurity.

Cost-effective irrigation and improved practices, developed through agricultural research, are examples of agricultural investment outcomes. Strategies should be developed and implemented to benefit local communities and to ensure environmental sustainability. Investments in agriculture will improve the competitiveness of domestic production and increase farmers' profits as well as bring down food prices (27).

2.4.4 The food security drivers

As discussed in section 2.3, p.8, the mere availability of food does not ensure food security. This is confirmed by the global scenario where food insecurity prevails amidst sufficient availability of food. The global food security situation has been blamed on market forces and rising food prices (22,37) but the situation is more complex than this linear relationship. When addressing food security, the traditional approach of food supply versus food demand is no longer sufficient.

Issues like population growth, income growth, increased urbanisation, changing diets, inadequate access to production inputs, rural infrastructure, the demand for biofuel production, social justice and the vulnerability of the food system, are all relevant topics in the food security discourse (38,39,40). These studies highlight the fact that food availability and access are not only a matter

of agricultural production, but are issues that require attention throughout the entire food value chain, including processing, distribution, marketing, retail, consumption, and waste management. The way in which the modern food system functions is questionable (41) and this is discussed in more detail in Chapter 3.

2.5 Food security in South Africa

South Africa is an upper-middle income country and is ranked as one of the countries with the highest rate of income inequality in the world. The socio-economic disparities play a role in the prevalence of food insecurity in the country. The food security status of South Africa may be misleading; it is stated that on a national level, South Africa is, on the whole, considered food secure (22,24). However, a large proportion of households are still considered to be food insecure (42).

Serious hunger is found throughout the country (43) and it is not only a reality for rural households (44). Based on the 2005/2006 Income and Expenditure Survey, only 18% (1 in 5) of households in South Africa spend enough to meet the dietary energy cost of a basic food basket[3] (45). A similar study was done in 2010 and it was found that the consumption of an adequate, balanced diet is out of reach for the majority of poor households in South Africa (46).

The National Food Consumption Survey (NFCS) of 2005 recorded that 52% of South African households experienced hunger[4] in 2005 and 60% of all deaths of children below five years of age in 2010, were associated with malnutrition (47,48). As is the case worldwide; the cause of hunger and malnutrition in South Africa is not rooted in a shortage of food, but is rather due to an inadequate access to food (49).

Jacobs (50) did a study to determine how the food price inflation in 2007-2009 and also the 2008-2009 economic crises affected the household food security status in South Africa. Data from the 2008 Generalized Household Survey (GHS) were analysed and according to him, all South Africans were affected by these shocks to some degree. There was a rise in commodity prices of maize and wheat, which is the staple diet of the poor in South Africa. The increase in food prices,

[3]The food basket consists of the foods the average South African adult purchases every month. This was converted into daily energy values and linked to the food prices, to estimate the cost of dietary energy (45).

[4] According to the Hunger Scale Index; 8 questions probing aspects of hunger.

towards the end of 2007, could especially be seen in the retail price of food, mostly in the above mentioned grains and cereals, but also in most vegetables and meats. The price increase forced low-income households to allocate an even greater proportion of their income to food and this resulted in less diverse and lower quality diets (24). Jacobs found that in 2008, 2-3% more South African households experienced hunger compared to 2006 and 2007 (50).

Due to different measurements and data sources used in the above mentioned studies, a meaningful estimate of food insecurity in South Africa is extremely difficult. Nevertheless, "*we can say with some certainty that a large proportion of South African households are food insecure*" (42).

The Human Science Research Council (HSRC) recently carried out an assessment of the food security status in South Africa (22,42). They revealed information regarding food security and related issues in the country and the following are among their key findings:

- The depth of household food insecurity is an urgent problem
- Low-income households spend a significant portion of their income on food and cannot afford a nutritious diet[5]
- There are specific food distribution and accessibility problems in South Africa
- Income security is an essential ingredient in any plan to combat food insecurity, but it is not the only factor that needs to be taken into consideration

2.6 Chapter summary

This chapter forms the foundation on which the rest of the study is built. The first step in managing food security is to grasp the multi dimensionality of the concept. The root cause of food insecurity was initially only traced back to food production issues. In the development of the food security concept, it became clear that it is a complex phenomenon with multiple factors that contribute to food insecurity.

"Food security and the food system operates within the culture of its community, the economy of its nation, and a market that extends around the world" (51). The analysis of the recent trends

[5] The lowest expenditure quintile of the population in South Africa allocated 37% of their income on food and non-alcoholic beverages in 2005/2006 (43).

and challenges in food security on a global level is essential to provide decision makers with the needed information to equip themselves in responding appropriately and effectively on a national, regional and community level (52). The global food security situation reveals that there is enough food to meet the world food demand, but that access to food remains a core issue.

After investigating the situation in South Africa, it was also discovered that food access, and not food availability, is the key determinant contributing to food insecurity (section 2.5, p.15). Food access is influenced by both unemployment and low income, but it is critical to move away from this linear way of conceptualising food insecurity. These are important factors, but it is necessary to investigate how the workings of the food distribution system determine food access, to better understand the food security status of South Africa (42). The structure of the food system is a significant contributor to food security and a better understanding of the system can help identify opportunities to address food access problems. To improve the food security status in South Africa, the dynamics of the food system must be investigated and structural constraints within the system must be identified and alleviated (22,42).

3. The Food System

3.1 Introduction

The food system has been identified as a key area of investigation in the South African food security context. The previous chapter revealed that food security studies in South Africa are mostly based on income poverty, as a proxy indicator. The limitation of these studies is that food insecurity figures are derived from the proportions of income spent on food, or the number of individuals who missed meals, because of limited or lack of income. Food access failure can thus only be traced back to a lack of financial resources (53).

Studies on the impact of the industrialisation and globalisation of the food system are becoming more prominent in the discourse on food security (39). These studies outline the fact that food availability and access are not only a matter of agricultural production, but also require the attention to the entire food system. The food system needs to be considered as a determinant of food insecurity. This statement is supported by Battersby (53); she argues that there must be some kind of failure in the modern food system, because of the high prevalence of food insecurity in cities and communities. There are structural problems in both the formal and informal markets and also an undesirable disparity between the two sectors. The food system and the specific role of the informal food retail sector must be investigated to determine the driving factors of food insecurity.

This chapter investigates the food system and determines how it contributes to the food security status of low-income communities (objective (i), p. 3). The development and globalisation of the food system is first presented (section 3.2) and, this is then discussed in connection with the idea of localising the food system (section 3.3). The food distribution network (section 3.4), and especially the food retail sector, is identified as one of the main role players in food security in the modernised food system. The formal (section 3.4.1) and informal (section 3.4.2) food retail sector of South Africa are discussed and finally, the effect of globalisation on the food retail environment is investigated (section 3.5), with specific focus on how it influences community food security (section 3.6).

The findings were used to create a sound theoretical framework from which the research process was developed (Figure 6, p.34) to reach objective (ii) on p.3.

3.2 The development and globalisation of the food system

A system is a "*collection of interrelated elements, forming a meaningful whole*" (54). The food system refers to the chain of activities connecting primary producers, manufacturers, processors, wholesalers, retailers and consumers. The figure shown below (Figure 4) is a simplified graphical representation of the connection between the different entities in the system.

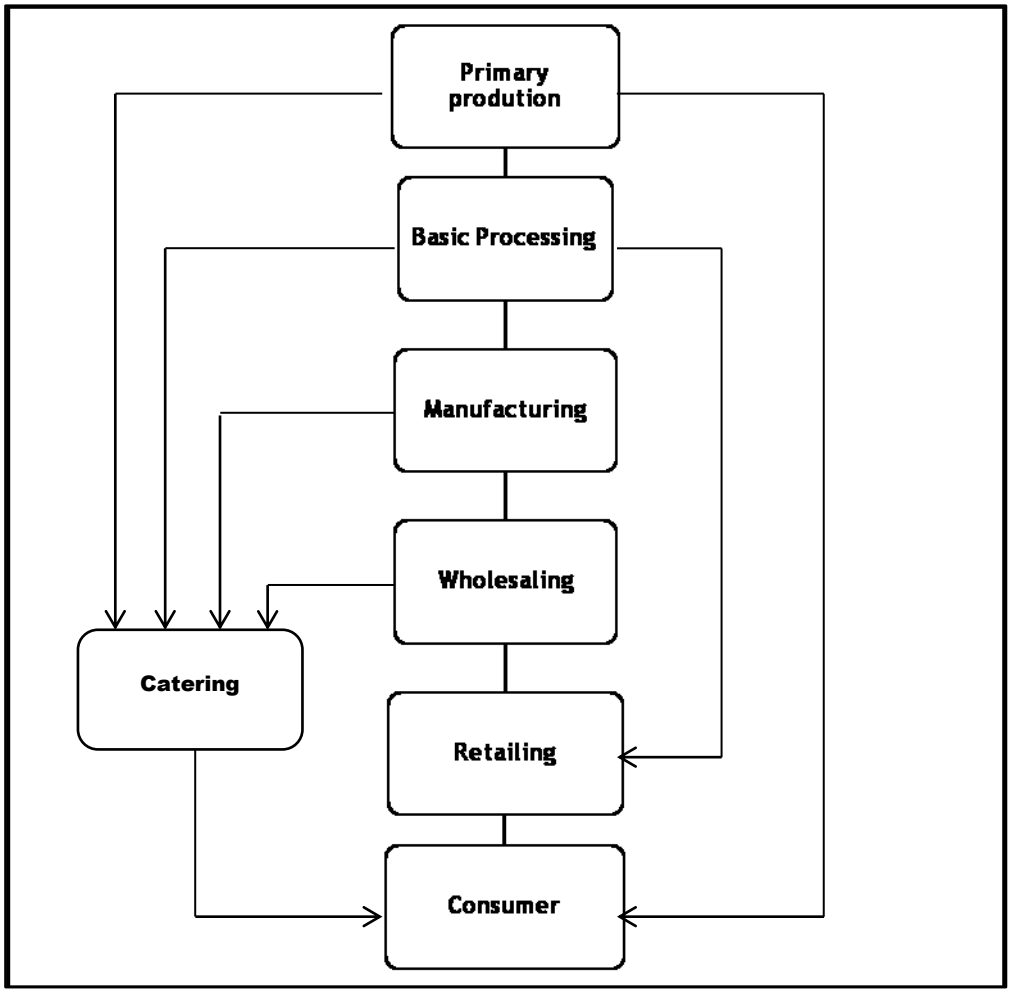


Figure 4 The food system (55)

The food system can also be referred to as the food supply chain or food value chain. At each stage in the chain, "value" is added to the product, costs are determined, profit margins are incorporated and the product is then distributed to the next stage (56,57). From the farm, raw

materials are sent to manufacturers where some kind of processing will take place. At the manufacturers food can be processed, for instance, the milling of the grain into flour. Even simple grading, trimming, washing and packaging can add value to the food item. Food from the farm can also be sent directly to processing companies where processes like tinning, preserving or juicing are performed. Processed products are then either sent directly to retailers, or to wholesalers for distribution. In the case of catering the food products are sent to specialist wholesalers that supply the caterers. At each step of the system the consumer forms part of the end of the food value chain (56).

The food supply chain has evolved from a simple producer-consumer structure to an integrated structure of strategically managed supply chains (51). The initial food supply chain structure was dyadic, with a direct link between the producer and the consumer. As the chain evolved, more intermediaries were needed between these two entities and it was extended to a chain-like structure (Figure 5). Today, the food system operates more like a network; this includes a network of suppliers, manufacturers, processors, distribution centers and customer locations (58).

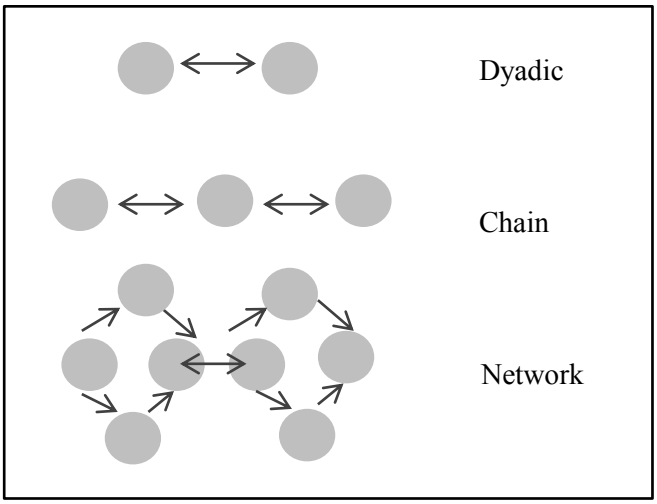


Figure 5 Different supply chain structures (58)

The way food is grown, processed, distributed and consumed has undergone radical changes over the last decade. It started off with the industrialisation of the agricultural sector; machinery began to replace human labour, feedlots replaced grazing, and monoculture replaced smallholdings (59). An increasing concentration took place at every link in the food system, as food processing

practices and the food retail sector, industrialised (60). The globalisation and industrialisation of the food system brought forth a whole new food economy[6].

There is an enormous market for new food products and services, and large multinational corporations are increasingly dominating the global food economy (58). A growing emphasis has been placed on product development, packaging, branding and advertising, and the increasing use of technology creates perceived quality in consistency (59,61). The food value chain is demand driven, as consumers and retailers continuously demand high quality and differentiated food products (51). The globalisation of the food system has produced a variety of benefits and can deliver, in theory, enough food to end world hunger (section 2.4.3, p.13). Globally, there are 25 000 products in the average supermarket, and more than 22 000 new packaged foods and beverages were introduced to the market in 2002 alone. For the consumers who are able to access this food, there is a selection of food available both in and out of season (59).

The way in which the modernized food system functions, threatens the sustainability of the system. The industrialised food system results in a high externalisation of social and environmental costs and one of the major problems is that costs are not internalised within the operating system (41). Among other causes of concern are the increasing environmental destruction, caused by the food system, and the way it influences food security on a global, national and community level (59,62,63). Box 2 (p.22) provides an example of food distribution in Britain, to illustrate the working of a modernised food system.

[6]The food economy is defined as the entire food chain including crop seeds, animals, agricultural input industries, ingredients and flavours of the food manufacturers, retail stores, food service establishments and the food we eat. It also encompasses the complex transportation and distribution system that links all these chain components (51).

Box 2: Food distribution in Britain:

Trade liberalization and global distribution networks, fueled by economies of scale, brought forth new possibilities in the operation of the food system. In Britain in 2001, 111 million litres of milk were exported and 173 million litres were imported and, in the same year, 47 million kilograms of butter were exported and 49 million kilograms were in turn imported (64).

3.3 Localisation of the food system

There is a movement back to the dyadic type of food system in an attempt to simplify, re-connect and re-localize the food value chain. Localisation of the food system is postulated as a way to counter the negative effects of the globalised food system. Researchers have suggested that localisation re-internalizes the costs in a food system, promotes the development of local communities and tightens the feedback loops to ensure effective management of the system. A direct link between producers and consumers are realized through a number of ways, for instance; through farmers' markets[7], public procurement initiatives[8], and community or urban agriculture (56,59,65,66).

There are benefits to localizing the food system, as it is a way to ensure that local communities become more sustainable, equitable, resilient and empowered (66,68). The food system of Stellenbosch was investigated to determine the viability of completely localizing the food system. In the investigation, it was identified that the local producers could not compete with the retail prices of the imported foods sold at the supermarket chain stores. There were also specific geographical constraints that limited the food production capability of the Stellenbosch region. Other myriad distribution and consumption challenges in localizing the food system were identified, but it was concluded that the current food system of Stellenbosch does have the

[7]Farmers' markets are outlets where fresh produce or food that has undergone minimum processing is sold. These types of markets are growing and expanding at a rapid pace (56).

[8]Public procurement initiatives are when farmers and public institutions sign contracts to ensure a regular supply of produce for the institution and a stable market for the farmers (67).

potential to promote a stronger local food economy (69). More details of the food system in the Stellenbosch region are given in Box 3.

Box 3: The food system in the Stellenbosch region

Information from the most recent food security studies conducted in the Stellenbosch region were gathered and analysed to develop an effective food system strategy for this district. Comprehensive research concluded that the current food system in the Stellenbosch area is not sustainable on a social, ecological nor financial level. The highlights of the report are listed below:

- Food insecure residents in Stellenbosch (estimated from a variety of reports): **28%**
- Meals served by faith-based organisations (FBO) and NGOs in Stellenbosch daily: **9 014**
- Meals served by FBOs and NGOs in broader Stellenbosch region daily: **27 000**
- There is an increase in local food markets with locally produced produce and products
- Small and large scale farmers are shifting to more agro-ecological farming typologies (70)

The localisation of a food system is not necessarily relevant to all countries, regions and communities, given their different logistical, geographical, political, social and economic environments (71). In fact, the idea of localisation could create barriers around a region, rather than incorporating the benefits of a global food system. Local food prices escalate easily resulting in the exclusion of the community from local food systems (72,73,74).

A food system is complex and the dynamics of it emerge from the relationship between the various components of the system. If the production or processing entity becomes more efficient and sustainable, it would not ensure the overall efficiency and sustainability of the food system,

without the working of an efficient distribution network (75). The identification of the structural blockages in the distribution system is the first step enable the efficient working of the entire food system.

3.4 The food distribution system

Distribution is not only a system component (Figure 4, p.19) but acts as an interactive link between the different system entities. The food distribution network includes wholesalers, retailers, restaurants and farmers' markets and the different means through which food is distributed is diversifying. It is difficult to develop quantitative measures for distribution, but it is possible to evaluate the degree to which the different players in the food distribution network contribute to food security (76). There has been a rapid growth in the number of supermarkets globally and this has created fundamental changes in the food system and specifically how food is distributed (36).

In the globalised food system, supermarkets have become the central point for food distribution (59,77). It is widely acknowledged that modern retailing can be seen as an important contributor to food security, as it ensures a regular supply of food and brings down food prices through their efficient food supply chains and procurement systems (36,78,79,80,81).

In contrast, there is an argument that supermarkets are a threat to food security and jeopardize the sustainability of agri-food systems (82). The dominant role that supermarkets play in the food system places them in a position where they can dictate food prices. Supermarkets can charge consumers maximum prices and pay minimal prices to producers (83). There are some concerns regarding the excessive profits that retailers make, but relative returns are difficult to assess (58). The rapid rise of supermarkets has also saturated the food retail sector. The modernization and sophistication of the global markets marginalises the rural poor producers and it is these markets that producers have to enter to help them to escape poverty (36,81). For every job created in the local economy by supermarkets, two to three jobs are lost (64).

It is predicted that the current trend in the food retail sector will continue and that the sophisticated supermarket supply system will continue to dominate (36). As was explained in the problem statement (section 1.2, p.2), access to stores that sell affordable, nutritious food is a prerequisite for adopting a healthy diet (84,85) and it is therefore important to investigate the food retail sector in more depth.

3.4.1 The formal food retail sector in South Africa

Supermarkets are the dominant players in most of the agri-food chains in South Africa, with a 55% share of the food retail market (82). South African households purchase 70-90% of their food supplies from supermarkets and major retailers (42). The six largest retail chains in South Africa are Shoprite, Pick 'n Pay, Spar, Massmart, Metcash and Woolworths; and they control over 94% of the grocery market (86).

All the large food retail chains in South Africa have their own volume and quality requirements. These ensure that high standards, concerning food safety and quality, are maintained to promote customer satisfaction. However, these standards create a barrier for small farmers wishing to enter the food retail market (36). Supermarkets obtain a stronger bargaining power with suppliers and this leads to a reduction of per unit fixed costs, of each transaction (81).

Wholesale markets in South Africa have developed and moved away from only serving the immediate local environment. "Fresh Markets" are an example of how wholesale markets have become larger and more centralized. These wholesale markets mainly supply fresh fruits and vegetables to retailers, but some also have their own retail sections. Freshmark is a specialized wholesaler, created and owned by Shoprite (82), and 93% of the produce provided to Freshmark, comes from commercial producers in South Africa (36).

3.4.2 The informal food retail Sector in South Africa

Supermarkets are generally far removed from the urban poor in South Africa, in contrast with the informal food retail market, which is more focused on providing food for these marginalised low-income consumers (53). As mentioned in the previous section (section 3.4.1), supermarkets has 55% of the food retail market, the remaining 45% of the food market lies outside the formal food retail sector and contributes significantly to the South African economy and to community food security (7).

The informal food retail sector in South Africa includes small general dealers, *spaza*[9] shops and street vendors[10] that usually comprise the food retail environment in low-income or rural communities (79). Greenberg (7) argues that these markets are important outlets for food distribution for the lower-income groups as they bring food retail outlets closer to the consumer. The informal market remains the main source of food for the poor (53).

The informal retail outlets cannot match the economies of scale of supermarkets (81). The prices of food tend to be higher in these local shops, compared to supermarkets and to the national average food prices (79,81). According to Ligthelm (87), small retailers are becoming a permanent phenomenon in the South African economic scene. To date, little research and interventions have been done to strengthen the informal food retail sector.

It has, however, been aknowledged that the important role of the informal food retail market must not be overlooked and that connections between the formal and the informal food sectors must be strengthened (53). If *spaza* shops are assisted in becoming more effective and efficient, it could boost the local economy and directly improve the socioeconomic and food security situation in low-income communities (53,87). Strategies to help the informal retail sector to make their distribution system more effective, could enable them to lower their retail prices (7,34). The profile of the informal food retail sector in South Africa is given in Box 4 to provide insight into this business sector.

[9]*Spazas* or tuck shops are defined as businesses operating in a section of an occupied residential home or in any other structure on a stand zoned or used for residential purposes and where people permanently live (87).

[10]Street vendors or hawker tables operate from a temporary or permanent structure on a street or at a taxi rank or train station (87).

Box 4: Profile of the informal food retail sector in South Africa

A national study was done to construct a profile of the informal retail sector in township areas in South Africa. The study was conducted amongst 481 informal retailers in communities throughout the country and the sample consisted of 66% *spaza* shops, 20% street vendors and 14% general dealers. The highlights of the study are summarised below:

- Street vendors with a matric certificate: 15.8%
- Informal retail outlet owners with formal business training: 10%
- Informal retail outlet owners unemployed prior to opening of business: 38.6%
- Main training needs: business management, bookkeeping, marketing
- Products delivered by suppliers: bread, sweets, soft drinks, cigarettes
- Average monthly turnover for *spaza* shops: R10 593
- Average monthly turnover for street vendors: R3 459
- Products that contribute most to *spaza* shops' monthly turnover: soft drinks, cigarettes, maize meal, alcoholic beverages, bread, sugar
- Main constraints experienced: shortage of merchandise, cash flow, transport, crime (87).

3.5 The effect of globalisation on the food retail environment

The modernised food system is not succeeding in providing low-income communities with access to a large variety of affordable food. Cole-Hamilton and Lang (88) were among the first to report that the reorganisation of the food retail sector had an impact on lower-income communities. The communities that they investigated had a limited variety of healthy food choices and high food prices. They found that low-income residents payed up to 21% more per week if they shopped locally compared to what it would cost them if they had access to the supermarkets situated closest to them.

Since then, numerous studies have been done to investigate the food retail environment of low-income communities. The concept of "food deserts", which originated alongside the globalised food system, can be defined as '*areas of relative exclusion where people experience physical and economic barriers to accessing healthy food*' (89). These areas usually lack food retail outlets, where affordable, nutritious food is available and local households are characterised by poverty

and poor nutritional status (9). The concept of food deserts conveys the idea that the location and type of market will affect a household's ability to access food. The globalisation and modernisation of the food system contributes to this phenomenon (90) and leaves low-income, minority communities spatially disadvantaged with regard to access to food (91,92). Several studies in America have reported that low-income areas often lack supermarkets and the most common type of food stores available are convenience or liquor stores that sell high-sugar and calorie-dense snacks. It was concluded that the immediate food retail environment limits residents' ability to make healthy dietary choices (93,94,95). Low-income residents, who don't own cars, tend to do their shopping within walking distance from their homes (96) and are dependent on the smaller shops where prices are high and the availability of fresh fruit and vegetables is inferior (13,42,97,98).

In a study to specifically determine if the poor actually pay more for food, the prices of supermarkets located outside low-income areas were compared to smaller shops available in communities within the Minneapolis and St. Paul metropolitan area, USA. With a few exceptions, the supermarket prices, located outside the communities, were found to be the lowest. Community residents, who have access to these supermarkets, could pay between 10 and 40% less per unit of measurement (99).

Communities with better access to supermarkets and larger food stores tend to have a healthier diet than non-agricultural communities living in food deserts (100). In an area with a higher concentration of supermarkets (11,101), more fruit and vegetables are consumed. Moreover, the presence of supermarkets is also associated with a lower prevalence of obesity and overweight individuals in low-income American communities (102). In a study conducted by Whelan et al., (103), focus group discussions were held to determine the physical and economic constraints of households in Seacroft (in Leeds) to obtain a healthy diet. The lack of local grocery stores meant that households had to make use of public transport to access supermarkets. This was a constraint, especially for the elderly who participated in the study. Food costs were also highlighted as a concern and the residents mostly purchased food in the budget stores, where the availability and quality of the food items was reduced.

In a study conducted among the retail outlets in two lower-middle-class communities in Chicago, it was found that food access is directly related to the store types available in a community. The investigated communities had few supermarkets and thus reduced accessibility to nutritious and

affordable foods. It was concluded that if residents had to rely solely on the grocery stores close to their homes, it would be difficult to obtain a wide variety of acceptable, good quality food (8).

Similar to Block's (8) research, food store surveys were used to assess the food retail environment of different neighborhoods in the USA, Canada and the UK. Data on the availability and prices of a predetermined list of food items were analysed. These studies found that the smaller, independent food retail outlets, or corner shops, stocked a smaller variety of food items, compared to supermarkets in the same research area. The food items available in the smaller stores were also mostly processed, carbohydrate based foods, with little variety of fresh produce. The prices in these stores also tended to be higher than the supermarkets (9,104,105). These findings are confirmed by Cummins (106) where the type of food retail outlet was identified as the main predictor of food price and availability.

In a more recent study, Sheldon et al. (107) determined the availability, affordability and accessibility of healthy food in a low-income community in Rhode Island. The retail outlet proximity to public transportation was also determined through the use of geographic information systems mapping. Most of the food items were available in the surrounding outlets, but the stores had prices of up to 40% higher than the national average retail prices. The results suggest that the low income residents in this community live in a nutritionally inadequate environment. The primary barrier to purchasing affordable, healthy food in this area was ascribed to the lack of a supermarket in the community. In a similar study conducted in three communities in Los Angeles, it was found that 100% of all the items were available at the supermarkets and at more competitive prices. The convenience stores, located in the community, mostly stocked food items that were high in fat and sugar. For example, 89% of the convenience stores that were surveyed sold Pepsi, but only 32% of them sold carrots (13). The lack of availability of healthy foods in low-income communities is an obstacle to maintaining a healthy, balanced diet (10).

Individual studies, done in America, suggest that there is no significant relationship between low-income areas and food prices (108,109). However, most studies confirm that supermarkets have the lowest prices and highest variety of available foods, compared to smaller shops found in low-income communities. Interviews with the owners of the smaller shops revealed that they have a limited understanding of the concept of healthy food options. Supermarkets, situated far from low-income areas, thus reduce the shopping opportunities of people living in these communities

(110,111). These studies highlight the need to better understand the food retail environment as well as the consumer behavior of low-income communities.

Minten and Reardon (112) did several studies to determine the prices and quality of food in retail outlets in African countries, including South Africa. The primary focus was placed on the price and quality of the products. According to them, there is a stable, predictable pattern that supermarkets offer better prices, availability and quality food products, compared to traditional markets in South Africa.

Two villages in the Transkei area in South Africa were investigated, and prices of selected food items in the formal and informal retail outlets were considered. It was found that the prices for processed foods, bread and sugar, in the *spaza* shops, were higher than the national average prices. The mark up for maize meal in the informal *spaza* shops was as high as 40%. The higher prices in the local shops were due to transportation and distribution costs. The study revealed that local shop owners procured their stock from the same supermarkets where consumers, who can access these supermarkets, did their shopping. *Spaza* shop owners have an extremely low financial liquidity and usually only buy small quantities of goods so wholesalers are not able to give them discounted prices. Households, where shopping is done at a supermarket, generally have a higher income than those who are forced to use their local stores. Households, with a higher income, thus have the means to travel once or twice per month and are able to buy in bulk. Consumers from the poorest households are attracted to the quality, price and variety of products that are available in supermarkets, but are marginalised in their access to these benefits (79).

In a study conducted in the rural towns of the Western Cape province of South Africa, the cost of adopting a healthier diet and the availability of appropriate foods in retail stores were investigated. The price and availability of the food items were recorded in a sample, consisting of supermarkets and small food stores[11]. Supermarkets sold most of the healthy foods at the most competitive prices, compared to the small stores that had a limited selection of healthy food choices. Most residents are able to travel to the larger towns to do their shopping at the supermarket, but there are some storage and transportation limitations. Low-income households have limited resources and can only make this trip once every week or two. The author concludes

[11]Small food stores were regarded as much smaller than supermarkets and having one to three staff members (5).

that switching from a traditional South African diet to a healthier version would cause a significant increase in food costs. This holds true for purchasing these healthier food items in both supermarkets and small food stores. This could be a major barrier for low-income households (5).

3.6 Community food security

The food security status of any group can be considered as the principal outcome of food systems (25). Low-income households are vulnerable to the food system in which they operate, causing any weakness in the food system to push them into food insecurity (14). As mentioned in the problem statement, p.2, the food security status of a community is intricately dependent on the community's food system (8). The definition of community food security confirms this by stating that community residents must be able to obtain a nutritionally adequate diet through a sustainable food system, that is economically and environmentally sound (84).

For community residents to be food secure, they must have permanent access to food that is nutritious and culturally acceptable, without growing dependent on grants or food handouts.
Community food security depends on the availability, quality and affordability of a variety of food items sold through retail or any other food sources. Households in informal settlements are dependent on the food distribution system in terms of the prices and the spatial availability of food retail outlets (14).

3.7 Chapter summary

The modernised food system was investigated to determine its contribution to the food security status of low-income communities. Ideally, a system would consist of different elements that interact to serve its purpose effectively. It is clear that the globalised food system solves one set of problems, but at the same time it results in the creation of other complex challenges (54). The idea of localizing the food system was also briefly investigated and found to be valuable in ensuring that local communities are better nourished, empowered and food secure. It is, however, not relevant for all regions and can easily create barriers and exclude that which is beneficial from the global food system.

As was mentioned in section 3.4, p.24, supermarkets have become a central point for food distribution in the globalized food system. This development in the food system creates food deserts that leave low-income communities marginalised in their ability to access a variety of

nutritious food. Low-income communities' food security is threatened and the food availability and accessibility problems are due to the structure and operation of the current modernised food system (14).

A community may be considered to be food insecure if there are inadequate nutritional resources or if they are not accessible to all community members. Thus, quantity and affordability of food, are pivotal issues in the matter of food security (85). These research findings were used to develop the systematic research approach (Figure 6, p.34). This was used to build an understanding of the current status of the local food system of Avian Park, in terms of food availability and accessibility (objective (ii), p.3). This research approach is presented in the next chapter.

4. Research Design and Methodology

4.1 Introduction

The systematic literature review in the previous chapter investigated the modernised food system and determined its contribution to the food security status of low-income communities (objective (i)). This created the theoretical framework, for a systematic research approach (Figure 6, p.34), developed to build an understanding of the current status of the local food distribution system (objective (ii)). Each step of the research process required different data and research methodologies, and this is summarised in Table 1, p.41. This chapter gives an outline of the research methodology used during the empirical research done in Avian Park.

4.2 Research design

The research design is aimed at meeting the following three research objectives:

i. to investigate the modernised food system and to determine how it contributes to the food security status of low-income communities;
ii. to gain an understanding of the current status of the local food system in Avian Park, focusing on the local food distribution system (concentrating on food availability and accessibility) and
iii. to provide technical information that local authorities could use in management and strategic planning, to ensure community food security.

The following systematic research approach is developed based on the findings of the previous chapter:

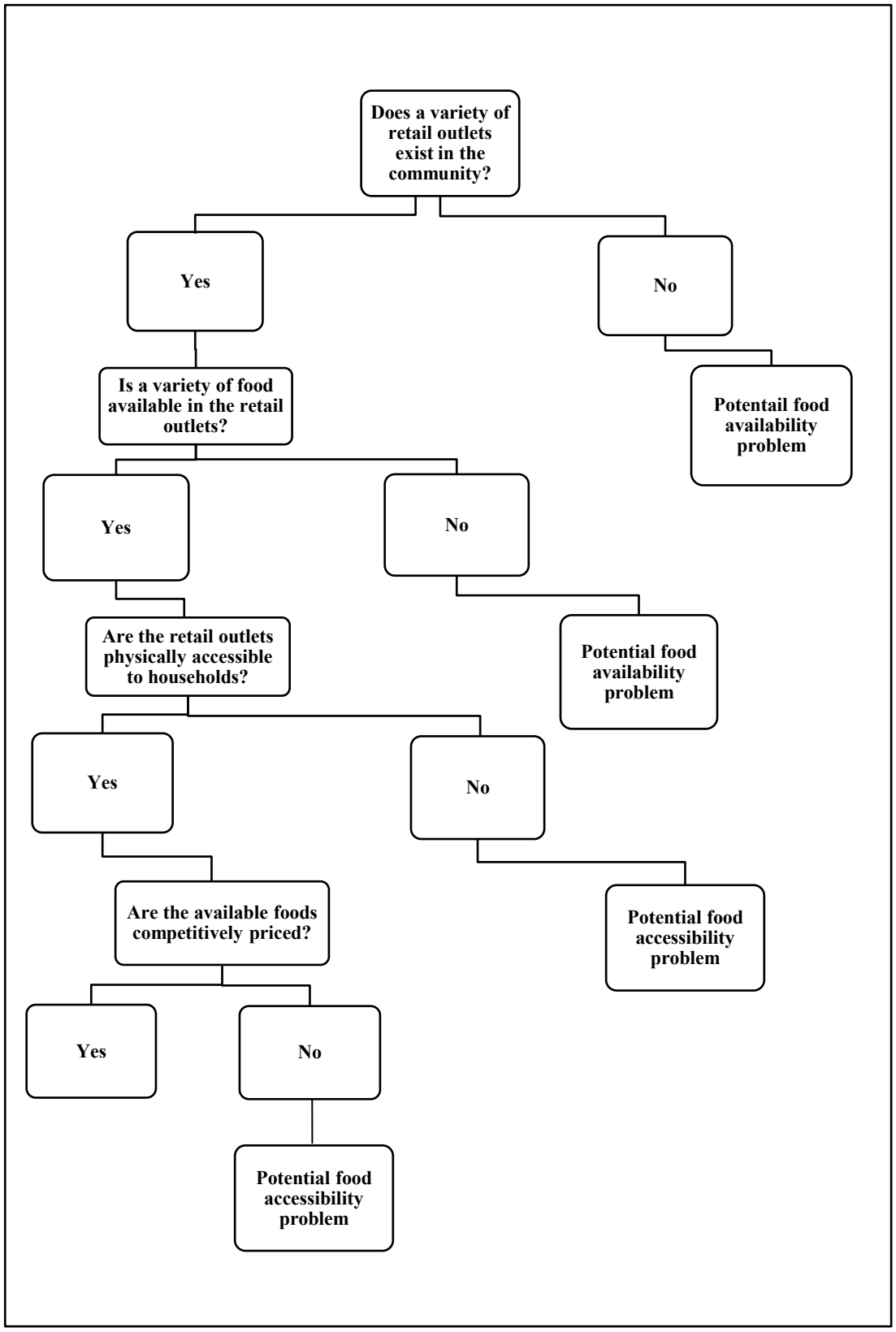


Figure 6 A systematic approach to food system analysis

4.3 Research methodology

This systematic research approach was implemented in the food distribution system of Avian Park, to reach objective (ii). A combination of primary and secondary data were collected from the Community Nutrition Security Research Project (CNSP), conducted by the Division of Human Nutrition.

A food store survey (see Appendix A), based on the USDA food store survey, was conducted amongst the food retail outlets of Avian Park to collect quantitative data on the availability, prices and sources of selected food items. Data collected from the CNSP, were analysed to further describe the food system of Avian Park and includes FGDs and household questionnaires.

Semi-structured interviews were held with a sample of the retail owners in both the formal and informal retail sector of Avian Park. The aim of the interviews was to give an overview of the complexities and inefficiencies in the food distribution system. This information was used to build the SD model to reach research objective (iii).

4.3.1 Study population

Avian Park is a community situated in the Breede Valley in the Western Cape Province of South Africa (Figure 7, p.36). The Breede Valley Municipality's agricultural activity is dominated by vineyards, growing grapes either for wine production or as fresh produce. In the areas surrounding Touwsrivier, livestock farming is predominant. There are also secondary agricultural yields like vegetables, grain, pears and apricots. Opportunities in citrus fruit production in the area have not been fully utilized. There are large areas of unoccupied land around the De Doorns region that could be used for agricultural development (113).

There are approximately 10 000 residents, of which 90% are coloured and 10% black. This area includes formal and informal housing sections and 21% of the residents are unemployed (114).

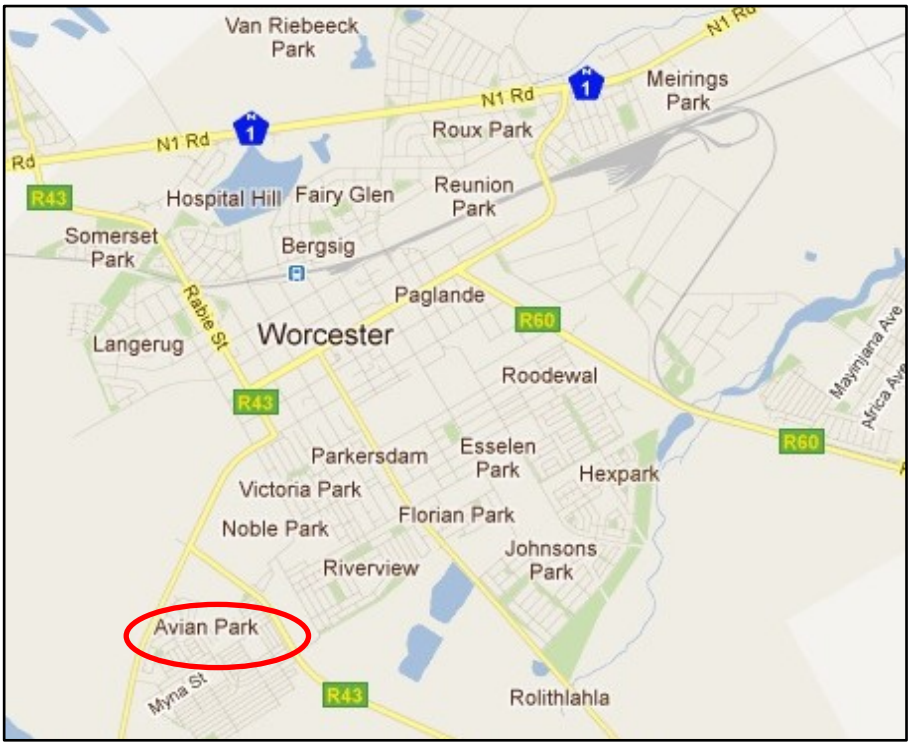


Figure 7 Avian Park

4.3.2 Sampling strategy

The study sample included 13 *spaza* shops, 3 chain supermarkets, 3 street vendors, 2 butchers, 2 wholesalers, a community café and a small, independent supermarket. The supermarkets that were visited most frequently by the community residents were determined through the Focus Group Discussions (FGD) and the selected wholesalers were identified through information obtained during the semi-structured interviews with the shop owners. The street vendors situated in front of the chain supermarkets were selected for investigation.

The *spaza* shops, included in the study, were randomly selected. The sampling frame was all the *spaza* shops within the community of Avian Park and a simple random selection of 13 *spaza* shops from the sampling frame was performed.

An area map of the community was obtained from the municipality. All the streets were numbered and 13 streets were randomly selected. One *spaza* shop from every randomly selected street was included in the study. The starting point at each street was selected at random to ensure that the starting points differed from street to street (Figure 8, p.37). In cases where there were no *spaza* shops in the street, another street was selected at random and a *spaza* shop in that

street was approached for participation. In situations where more than one *spaza* shop was situated in one street, participation was determined through random selection.

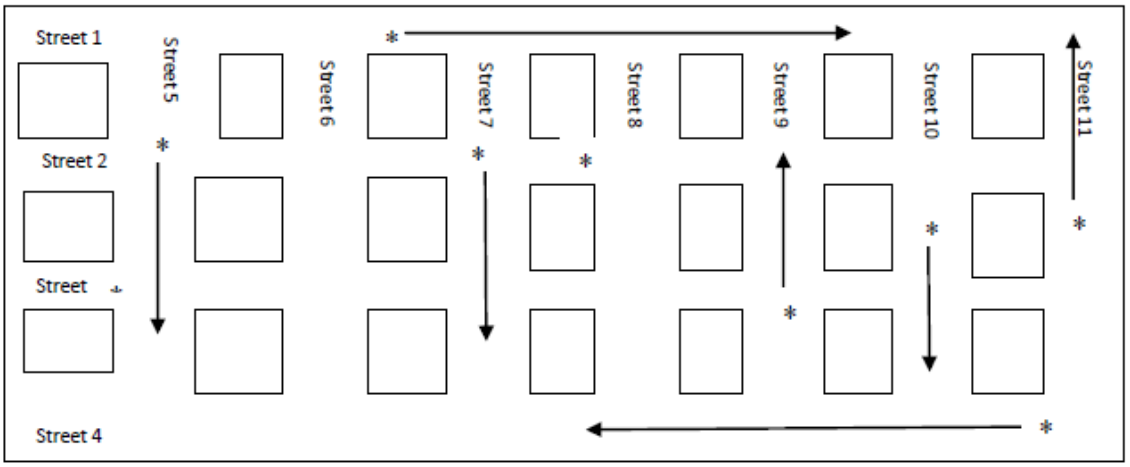


Figure 8 Schematic description of sampling strategy

4.3.3 The food store survey

A quantitative food store survey (see Appendix A), developed by the USDA (85), was adapted for this part of the study. The means of data collection was chosen for its quantitative nature and high measurement reliability (115). Specific questions; based on a national study done by the Bureau of Market Research, University of South Africa (116), concerning the food distribution system, were added.

The food store survey comprised of a list of food items, and the availability, price and source of these items were recorded among the different food retail outlets (85). The most commonly consumed foods in the community were selected for this survey. This was based on the Food Procurement Questionnaire undertaken in Avian Park, as part of the CNSP. The questionnaires were analysed and the most frequently consumed items were included in the list. The questionnaires were conducted among 220 households living in Avian Park (both formal and informal housing). An expert committee with dieticians from the Division of Human nutrition, with an in-depth knowledge of the food and dishes consumed in Avian Park, recommended a variety of healthy food items and these were included in the list.

Prices were collected in Rand/kg and in the cases where this was not indicated, the produce was weighed (117). This pricing methodology enabled comparisons of small sizes of items, in small food stores, to large sizes and private-label or generic items in large supermarkets (85).

4.3.4 Semi-structured interviews

In order to identify problem areas in the current food distribution system of Avian Park, it was important to investigate beyond the quantitative data. Interviews[12] with the owners and managers of the different food retail outlets were undertaken to gain a better understanding of the functioning of the current distribution system of Avian Park. This mode of data collection was chosen for its ability to gain in-depth insights into the study area. It assisted in the identification of the potential barriers, and opportunities, to promote greater efficiency in the local food distribution system and to identify key areas to include in the SD model as part of reaching research objective (iii).

The limited number of interviews conducted due to refusal rates (30%**)**, time constraints from the shop owners and language barriers can be considered to be limitations of this study. Twenty five interviews were done. Each interview took more or less 40 minutes to conduct and notes were taken by the researcher and field workers interchangeably. Two women residing in the community worked as fieldworkers and this created a platform of trust with the interviewees. Interviews were mostly done by the researcher in Afrikaans or English and were directed to the retailer owners and managers in both the formal and informal food retail sector of Avian Park. Where it was needed the experienced fieldworkers conducted the interviews in isiXhosa. The interviews were semi-structured, as a set of questions were included in the survey, but was adapted as the interview progressed.

4.3.5 Focus group discussions

Focus group discussions (FGD) were conducted to obtain insight into the personal views, cultural practices, beliefs and experiences of the different participants. The discussions were conducted among community residents to specifically investigate the availability and accessibility of food in the community.

[12]The interview questions is part of the food store survey, see Appendix A.

The FGDs were conducted according to the guidelines in the United States Department of Agriculture (USDA) Community Food Security Assessment Toolkit and adapted for the South African context. These discussions were held at a local clinic which was safe and easily accessible (close to public transport / taxi routes). The discussions lasted approximately 30 minutes and the participants were recruited using snowball sampling. A maximum of 8 people participated in a single FGD. The FGDs were conducted and notes were taken by trained, experienced fieldworkers, residing in the community. The discussions were also voice recorded and afterwards transcribed by the fieldworkers.

4.3.6 Ethical considerations

All the participants were provided with written information regarding the objective of the research project and the procedures to be followed[13]. Consent was obtained before participation. The participants were informed that they may refuse to participate in the research project and that refusal to participate will not in any way compromise them. All the information obtained during the study was handled in a confidential manner. No participant / retail outlet received incentives for their participation.

4.3.7 Data analysis

The data collected through the food store survey and from the CNSP conducted by the Division of Human Nutrition, were analysed to build an understanding of the current status of the local food system of Avian Park (objective (ii)). More specifically; food availability and accessibility in the local food retail sector were determined. A summary of the required data, research methodology and research outcome at each step of the process are provided at the end of this section (Table 1, p.41).

4.3.7.1 Food Availability

An insight into the community residents' experience of the availability of different food retail outlets and the food available were gained through the FGD. The completed food store surveys were also analysed to determine the overall availability of food in the community. Calculating the individual food items missing across all stores indicated whether the availability of particular food items were limited in the different food retail outlets.

[13]This is included in the food store survey, see Appendix A.

4.3.7.2 Food accessibility

The constraints in the physical accessibility to food were determined through the analysis of the FGD. The next step in determining food accessibility was to determine if the food in the community was competitively priced. This was determined with three price strategies. The first price analysis compared the prices of the different food categories across the different food retail outlets. Single factor ANOVA comparisons were performed to determine whether or not the means of the food prices across the different food retail outlets were equal. The prices of selected food items were also compared and specific comparisons between the informal and formal food retail sector were made. It is important to make this distinction to characterize the immediate food retail environment of the community which predominantly consists of *spaza* shops.

The second price analysis calculated the mark up of the food items in the informal food retail sector, to determine if they abuse their monopolistic power in the community. Finally the prices in all the different food retail outlets were compared with the national average retail prices[14]. A Nutritious Food Basket (NFB) was used as a survey tool to measure the cost of basic healthy eating across the different food retail outlets and the national average prices were used as the benchmark prices. A deeper insight into the affordability of food for the community residents was gained through the FGD.

4.3.7.3 Food system dynamics

The data collected through the semi-structured interviews and food store survey were analysed to identify the potential barriers and opportunities to promote greater efficiency in the local food distribution system and to highlight key areas to include in the system dynamics model, as part of reaching research objective (iii). This will be discussed in greater depth in Chapter 6.

[14] See Appendix B.

Table 1 Proposed measurements, methods and outcomes

Indicator	Data Required	Measurement	Methodology	Research Outcome
Food Availability	Qualitative data on food retail outlet availability	Food store availability	FGD	Research Objective (ii)
	Food availability in food retail outlets	Variety of food available in different food retail outlets	Food store survey	
Food Accessibility	Qualitative data on food store accessibility	Physical access	FGD	
	Food prices	Food affordability	Food store survey	
	NAMC food prices	Food price analysis		
Food system dynamics	Research findings	Structural constraints within the system	Semi-structured interviews	Research Objective (iii)
	Qualitative data on the food system		System dynamics modeling	

4.4 Chapter summary

The research design was built to meet the research objectives listed in section 4.2 on p.33. This chapter discussed the research design that was used for the empirical research done to build an understanding of the current status of the local food distribution system of Avian Park (objective (ii)). The application of this, to the food system of Avian Park, produced the research findings presented in the next chapter. The analysis of the research findings presented in the next chapter form the basis of meeting research objective (iii).

5. Research Findings

5.1 Introduction

The systematic research process (Figure 6 on p.34), mentioned in the previous chapter, was followed to investigate the food system of Avian Park. The research findings are presented in this chapter and are used to characterize the food retail environment of the community, in terms of food availability and accessibility.

Food availability (section 5.2) will first be investigated. This is followed by analysing the food accessibility (5.3) for the community residents of Avian Park. Data obtained from the semi-structured interviews are given and discussed at the end of the chapter (section 5.4), to provide insight into the food retail sector of Avian Park.

5.2 Food availability

The data collected from the focus group discussion and the food store survey was analysed to determine the availability of food in the community.

5.2.1 Does a variety of food retail outlets exist in the community?

The retail environment of Avian Park mainly consists of *spaza* shops that are spread throughout the community. There is almost one *spaza* shop in every street, except in the more informal and poorer neighborhoods in the community, where these outlets are fewer in number. Most of the residents of Avian Park live within walking distance of a *spaza* shop. Given this situation, the availability and price of food at these shops do affect the food security of the residents of Avian Park. The importance of *spaza* shops is even further emphasized when the restricted access to the nearest chain supermarkets is taken into account. The most striking limitation of Avian Park's food retail environment is the lack of chain supermarkets.

Apart from the *spaza* shops, Avian Park has a mini supermarket in the center of the community, and a café on the outskirts of the community, made available to approximately 10 000 residents. According to the women in the community there is a need for a butchery and more fruit and vegetable retail outlets that are within walking distance from the households. There are a variety of supermarkets and street vendors that sell fresh fruit and vegetables and there are also butcheries in Worcester, a town, which is 4-5km from Avian Park.

5.2.2 Is a variety of food available in the retail outlets?

The most commonly available items in the *spaza* shops are carbonated drinks (100% of all the outlets sold these products), sweets and chocolates (100% of all the outlets sold these items) and basic staple and processed food items such as rice, maize meal, long life milk and tinned food. The less readily available foods in the *spaza* shops were often the healthier items such as; whole wheat bread, green vegetables and fresh meats.

In terms of fresh produce, onions and potatoes were stocked in 58% and 67% of the *spaza* shops respectively. A frequency count shows that only 17% of the *spaza* shops sold apples and 25% sold bananas. None of the *spaza* shops sold carrots or green vegetables and only 17% had tomatoes available at the time of the survey. *Spaza* shop owners stated that they do not carry a variety of fruit and vegetables because of the problem of spoilage, space limitations in the stores, storage issues and the lack of transport. On average, 50% of the *spaza* shops sell meat, but it is predominantly chicken chunks or soup packs. The meat that is sold at the *spaza* shops is not always fresh and at times even rotten.

The café in the community stocked just over half (56%) of the food items included in the survey. The *spaza* shops had 66% of the items available; just 3% less than the food stocked by the small supermarket in the community (Table 2). A variety of vegetables could be purchased by the community from the café and the small supermarket, which include butternut, green beans, cucumber and cabbage. The small supermarket in the centre of the community sells chicken pieces, chicken chunks, offal and sausage. All the items in the survey were available at the supermarkets in town and the street vendors sold 78% of the fruit and vegetables included in the survey.

Table 2 Food availability across different food retail outlets

Outlet Type	Food item Availability (%)
Café in Community	56%
Small supermarket in community	69%
***Spaza* shops**	66%
Supermarket	100%

5.3 Food accessibility

Food accessibility in the community was determined through the analysis of data collected through the focus group discussions and the food store survey.

5.3.1 Are the retail outlets physically accessible to households?

The residents of Avian Park have relatively easy access to the *spaza* shops, as they are distributed throughout Avian Park. It is, however, more difficult to access the variety of retail outlets that is available in town. The nearest chain supermarket to Avian Park is 4-5km away in Worcester (Figure 9). Most of the residents do not own their own vehicles, walking is reported to be dangerous and taxi fees are considered unaffordable.

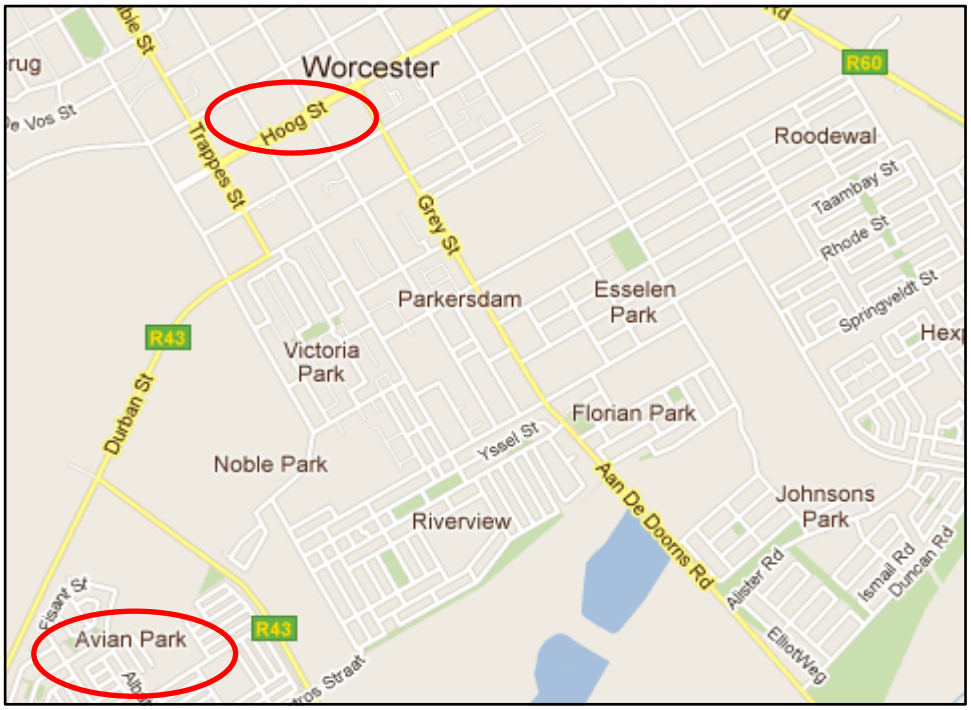


Figure 9 Distance from Avian Park to the closest chain supermarket

5.3.2 Are the available foods competitively priced?

Food is perceived to be expensive. The participants reported that their budget does not allow for the purchasing of a variety of healthy food for their families. The households that are dependent on government grants or pension are especially limited in their access to food, in terms of affordability.

Three price analysis strategies were undertaken to determine if the food in the local retail outlets of Avian Park were competitively priced. The first analysis compared the prices of selected food items across the different food retail outlets. Specific comparisons between the informal and formal food retail sector were made to determine whether the informal sector could compete with the supermarkets. It is important to make this distinction, to characterize the immediate food retail environment of the community, which predominantly consists of *spaza* shops. The mark-up of the food items in the informal food retail sector is calculated to determine the efficiency of their business operations. Finally, the prices in all the different food retail outlets were then compared with the national average retail prices.

5.3.1.1 Price comparisons across the different retail outlets

The average retail prices of the five food categories are compared across the different food retail outlets (Figure 10). The data reveals an interesting finding when viewed in terms of each food category.

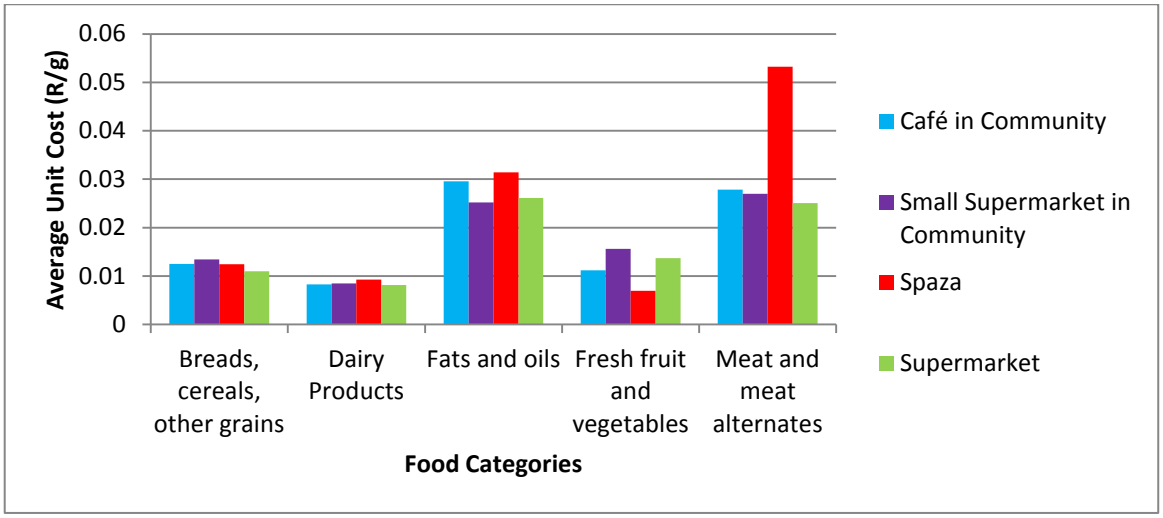


Figure 10 Price comparisons of the different food categories [15]

In particular, fresh fruit and vegetables are generally less expensive in the *spaza* shops than at the supermarkets. On the contrary, meat and meat alternatives are the highest priced in the *spaza* shops, if compared to the other food retail outlets.

[15]Using Anova tests, the price differences for fresh fruit and vegetables, and meat and meat alternatives vary significantly by store type (see Appendix C).

The average prices of the food items most frequently procured, among the residents, within the community, are compared across the different food retail outlets (Figure 11). The prices for the selected food items are very competitive; 6 out of the 9 selected items have similar prices.

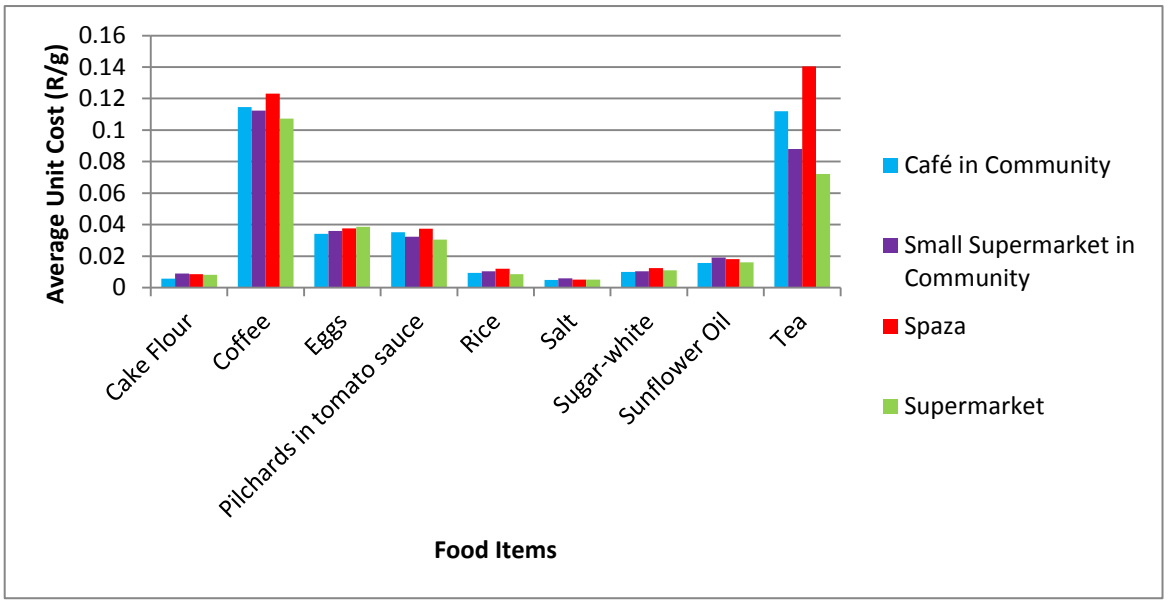


Figure 11Price comparisons of frequently procured food items

The retail prices for coffee, pilchards in tomato sauce, rice, sugar and tea are the highest in the *spaza* shops, when compared to the other retail outlets. There is a distinction between processed and staple food items in *spaza* shops, which tend to have the highest prices, and fresh fruit and vegetables, which are generally less expensive compared to the formal retail outlets.

The average prices of specific processed and staple food items are compared across the different retail outlets (Figure 12).

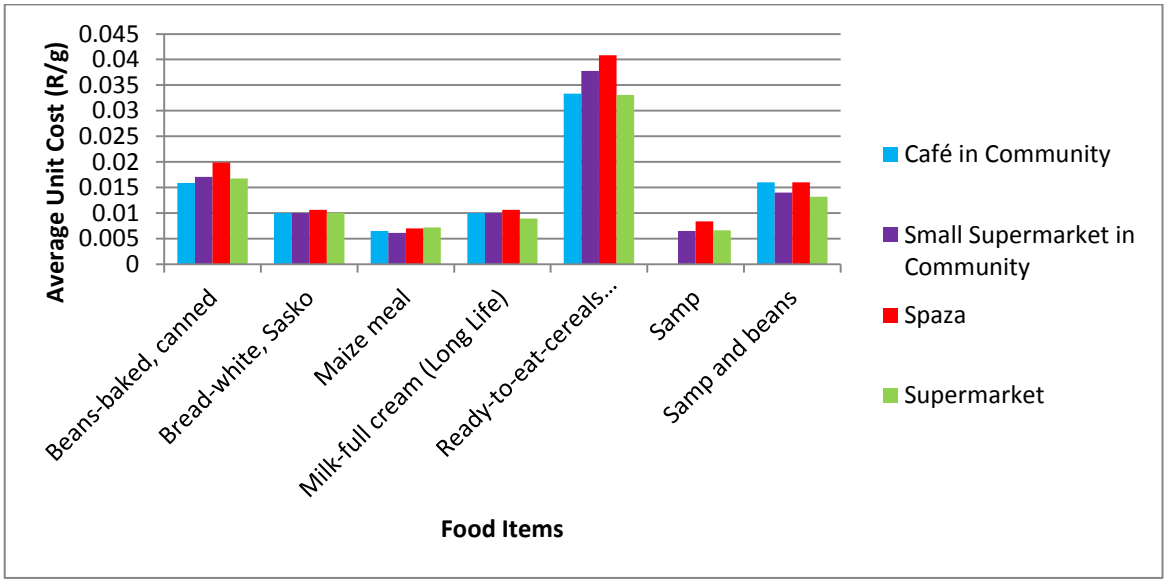


Figure 12 Price comparisons of processed and staple food items

The prices of all the processed and staple food items are highest in the *spaza* shops, except for maize meal and samp and beans, where the average prices in the different retail outlets are very similar.

The price for maize meal is further investigated to determine the pricing penalty for different packaging sizes. Figure 13 reveals that maize meal is in general slightly more expensive in the *spaza* shops than in the supermarkets. There is also a higher pricing penalty in buying small quantities of maize meal at the *spaza* shops compared to the supermarkets.

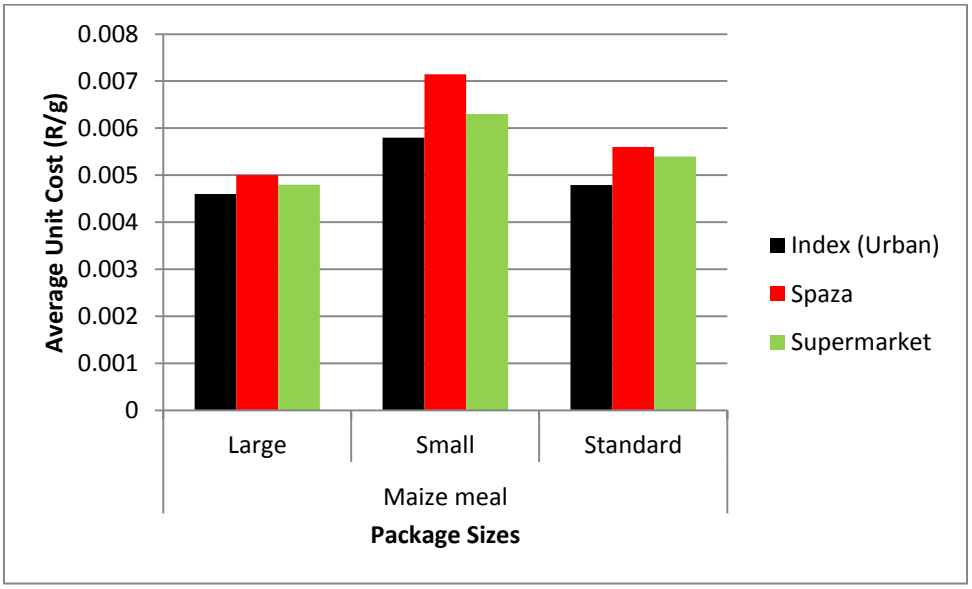


Figure 13 Maize meal price comparisons for different packaging sizes[16]

[16]5kg were classified as the "normal" packaged size. This is the size used in the NAMC food basket. All the sizes smaller than this were classified as "small" and bigger than this were classified as "large".

The prices for fresh produce vary more distinctly between the different outlets than for processed food items. Selected produce prices for fresh fruit and vegetables that are available in the *spaza* shops, street vendors and supermarkets were compared (Figure 14).

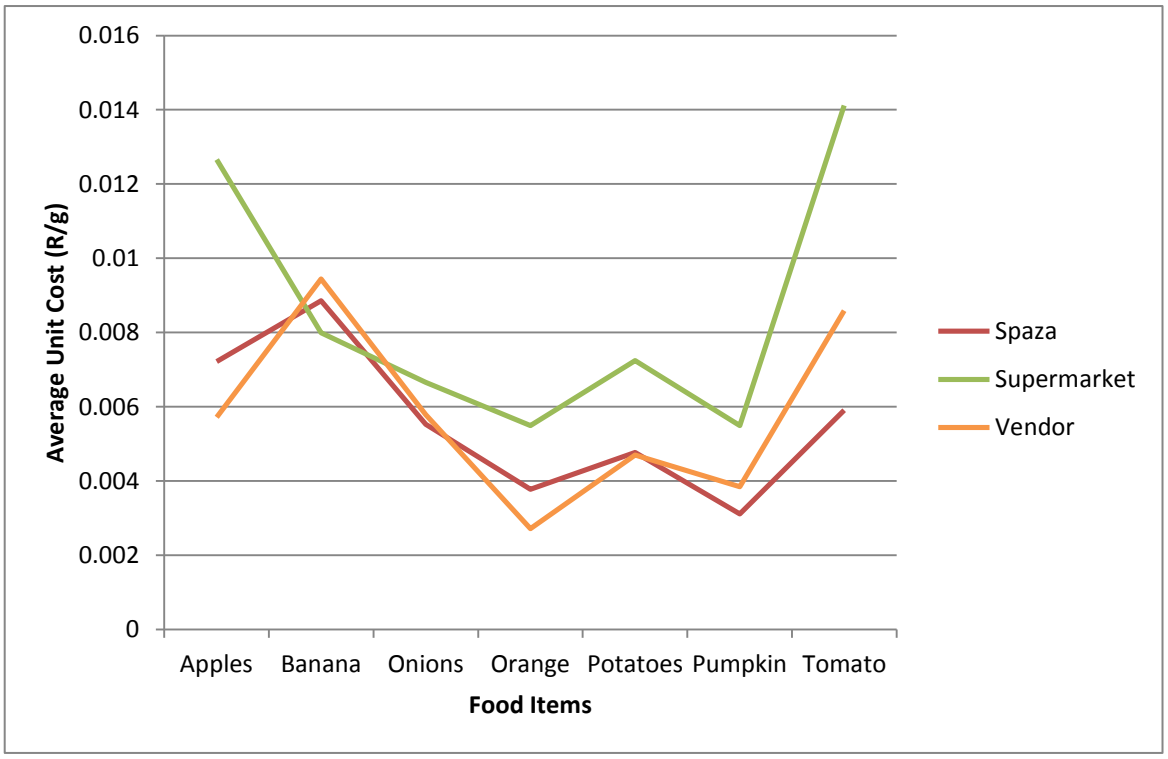


Figure 14 Price comparisons of fresh fruit and vegetables

For the selected fresh fruits and vegetables the supermarkets ask higher prices, compared to the informal retail sector, except for bananas. The prices between the different food items vary in the informal retail sector, but are closely correlated. *Spaza* shops have higher prices for apples, oranges and potatoes, compared to the street vendors that are situated in the nearby town. The café in the community has a small variety of fruit and vegetables available and it is important to determine if it is more affordable to buy fruit and vegetables in the community itself or in the nearby town.

The average prices for selected fruit and vegetables are compared between the café, situated in the community, and the supermarkets in the nearby town (Figure 15).

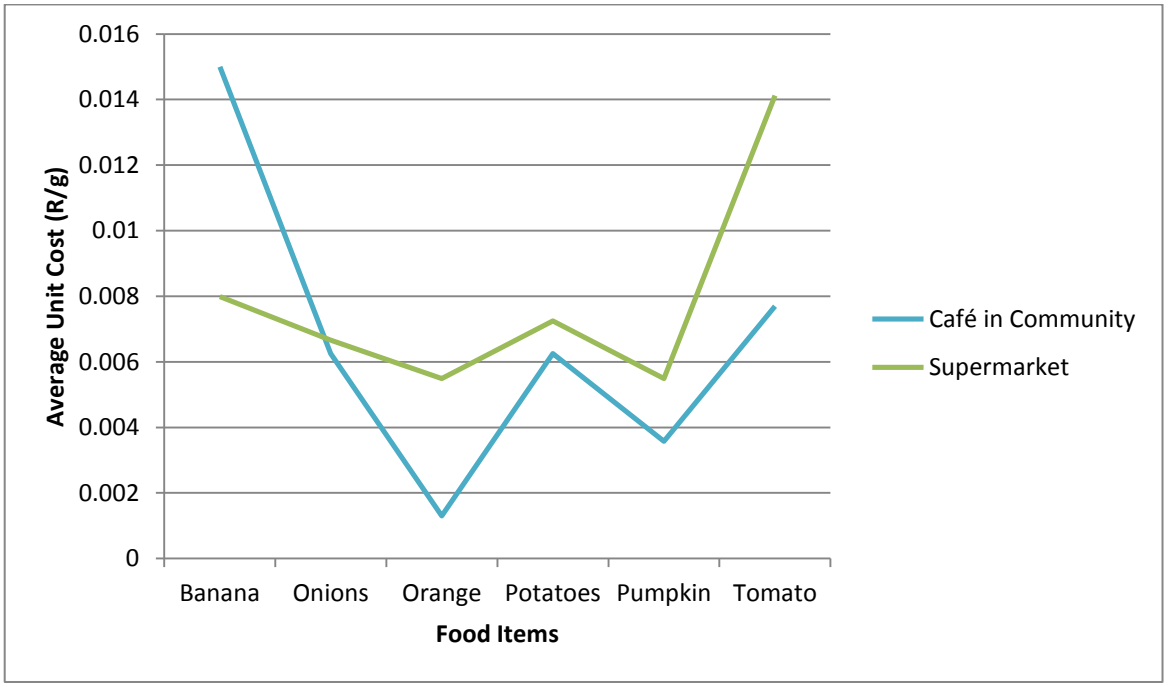


Figure 15 Price comparisons of fresh fruit and vegetables

With all the fruit and vegetables that are available in the café, it is less expensive to buy within the community than in the supermarkets in town. The only exception is bananas that are more expensive in the Café within the community.

To determine the difference in prices across the retail outlets for meat and chicken, product prices were compared. These prices were readily available in all the different retail outlets (Figure 16).

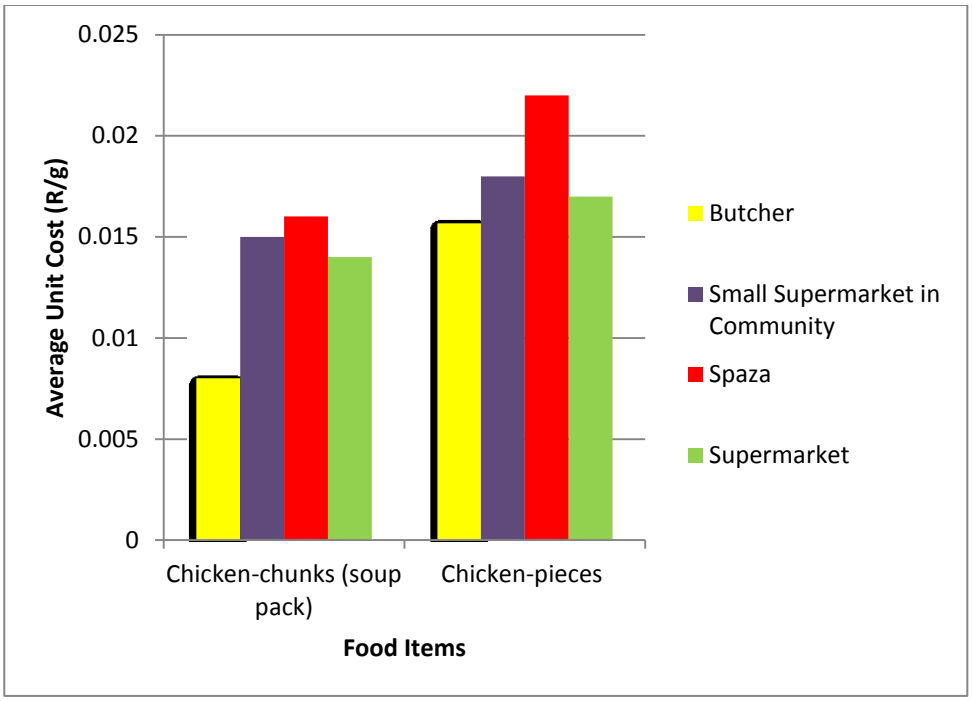


Figure 16 Price comparisons of chicken products

Figure 16 illustrates that it is more expensive to buy these chicken products within the community than at the butchers, situated in the nearby town. It costs 50% and 29% more to buy chicken chunks and chicken pieces respectively, at the *spaza* shops, than if it is bought at a butcher in town. For both of these chicken products, the small supermarket in the community charges higher prices compared to the supermarket in town.

5.3.1.2 The mark-up on food items in the informal retail sector

The wholesalers, where the informal retail owners buy their produce and products, were identified through the semi-structured interviews. Data on the food prices were collected at these wholesalers. The mark-up for the selected items were determined by calculating the margin between the wholesale price and the retail price in the local shops and expressed as a percentage.

The average mark up for fruit and vegetables in the informal food retail sector was determined (Table 3).

Table 3 Mark-up on fresh produce

Food Item	*Spaza*	Vendor
Apples	162%	108%
Avocado Pear	20%	87%
Banana	77%	89%
Cabbage	15%	38%
Carrots		67%
Green Beans		100%
Guavas		75%
Onions	84%	93%
Orange	202%	117%
Potatoes	99%	96%
Sweet Potato		13%
Tomato	9%	32%
Total (avg)	81%	76%

The average mark up varies between the different produce, ranging from 9% for tomatoes up to 202% for apples in the *spaza* shops and between 13% for sweet potatoes and 117% for oranges at the vendors. The *spaza* shops generally have a higher mark-up on average, compared to the street vendors for fresh fruit and vegetables.

The high mark-up for fruits and vegetables in the *spaza* shops and vendors are illustrated in the graphs below (Figure 17 and Figure 18).

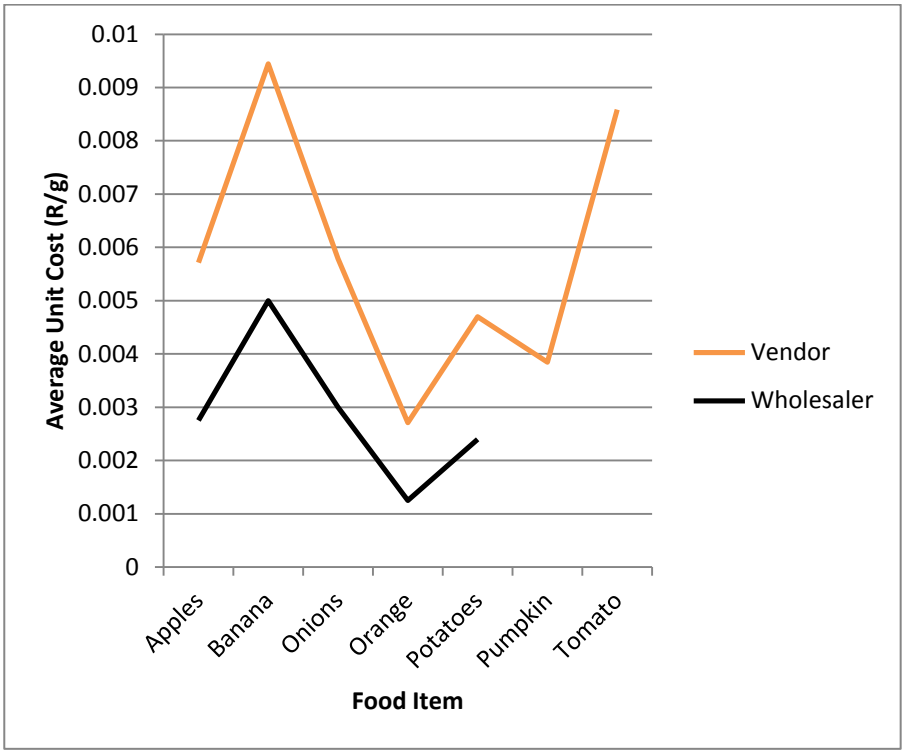


Figure 17 Mark-up on fresh fruit and vegetables for vendors

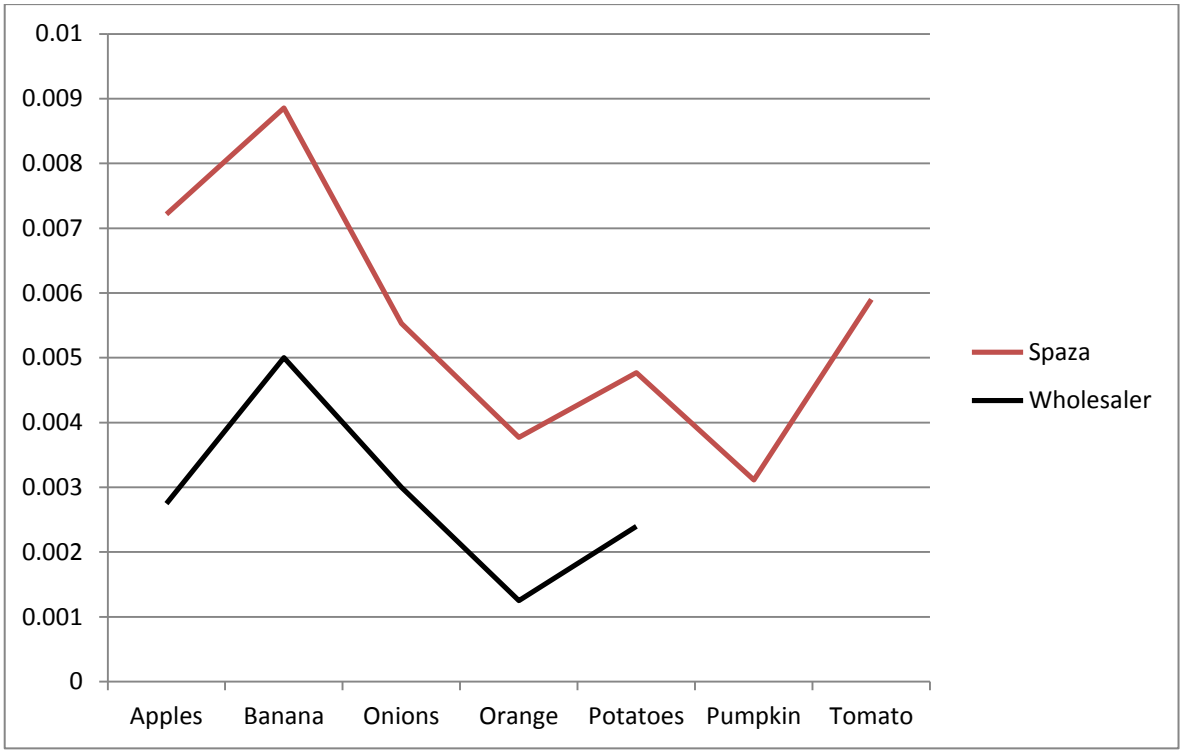


Figure 18 Mark-up on fresh fruit and vegetables in *spaza* shops

The two figures give a clear picture of the high mark-up values for fruit and vegetables in the informal retail sector. Yet the prices for fresh fruit and vegetables in the informal food retail sector are still reasonably competitive with the chain supermarkets.

The average mark up for processed and staple food items in the *spaza* shops are determined (Table 4).

Table 4 Mark-up on processed food items in *Spaza* shops

Product	*Spaza*
Beans, dried (sugar beans)	22%
Beans-baked, canned	37%
Bread-white, Sasko	9%
Cake Flour	36%
Chips-Snack Attack	116%
Coffee	11%
Cold drink, carbonated (Double O)	15%
Eggs	27%
Imana Soya Mince	22%
Lentils	6%
Maize meal	40%
Margarine	32%
Oats (uncooked)	36%
Peanut Butter	11%
Pilchards in tomato sauce	90%
Ready-to-eat-cereals (wheat bix)	23%
Rice	74%
Samp	62%
Samp and beans	82%
Sugar-white	22%
Sunflower Oil	52%
Tea	163%

The average mark up for processed food items in the *spaza* shops varies between the different food items ranging from 9% for bread to 163% for tea. After tea, the highest mark-up is followed by chips (116%), pilchards in tomato sauce (90%), samp and beans (82%) and rice (74%). These are among the food items that contribute most to the monthly turn-over of *spaza* shops. This is illustrated in the graph below (Figure 19).

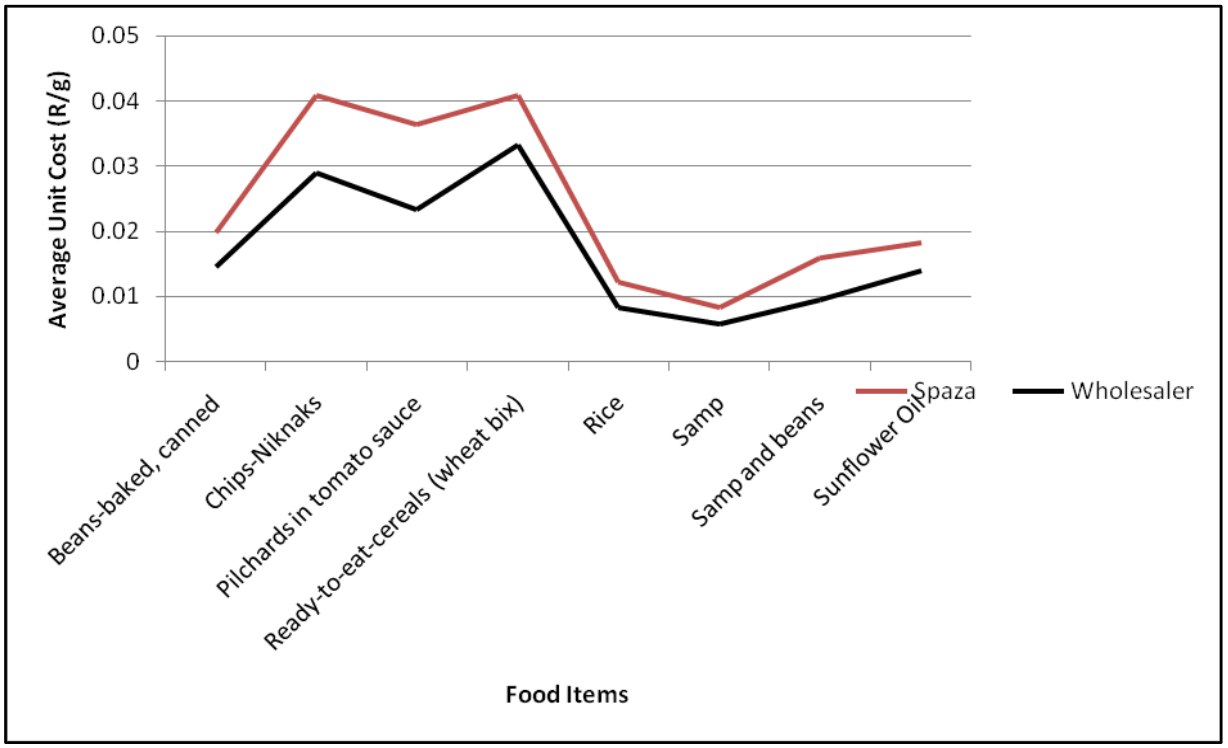


Figure 19 Mark up for food items in *spaza* shops

5.3.1.3 Price comparison with national average retail prices

The food prices for the different food categories, across the different retail outlets, were firstly compared with the national average (Figure 20).

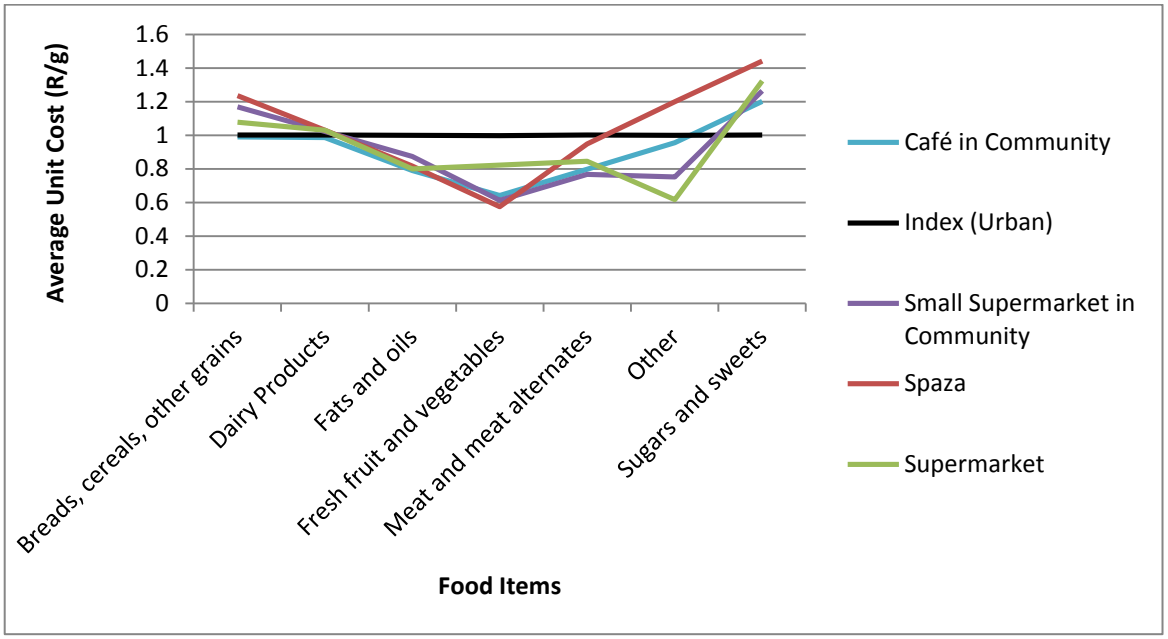


Figure 20 Food categories' prices compared to the national average

Food prices in Avian Park and the surrounding area are below the national average for all food categories except for breads, cereals and other grains and for sweets and sugars. Fresh fruit and vegetables are noticeably lower than the national average prices. This is confirmed by the next graph which takes specific fruit and vegetable prices into consideration (Figure 21).

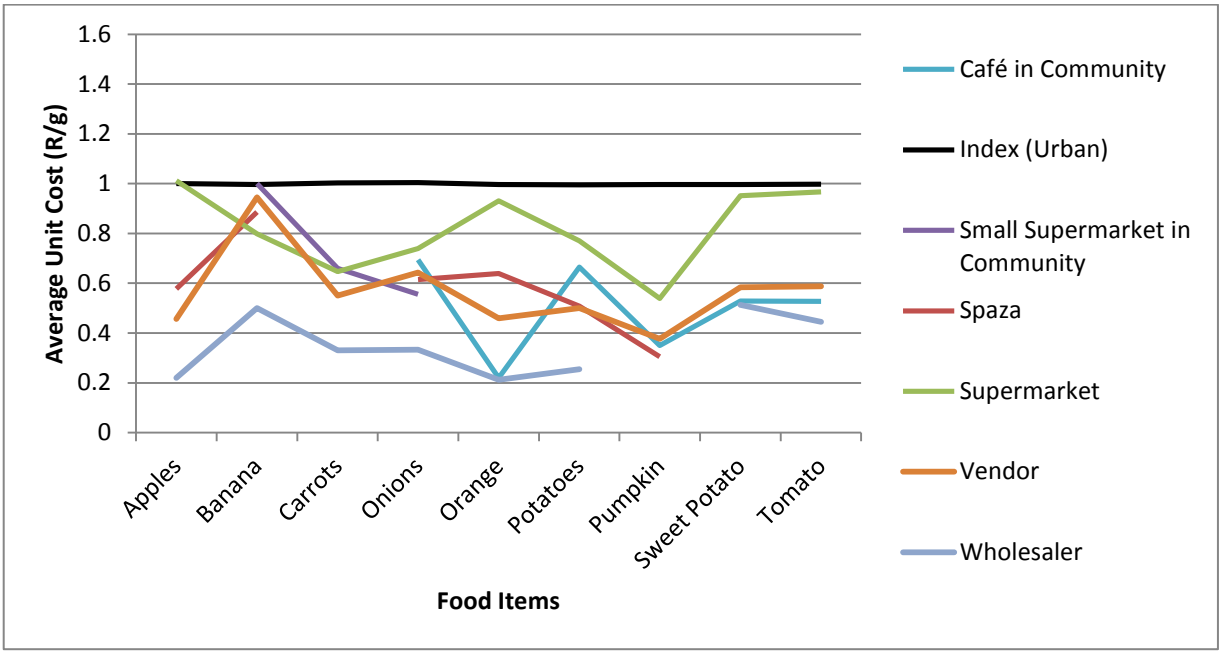


Figure 21 Fruit and Vegetables' prices compared to the national average

All the different retail outlets' fruit and vegetable prices are below the national average price. The following table (Table 5) includes food items from the NAMC Food Basket, which includes food items that the average South African adult purchases every month.

Market Basket	Price (R)
Basket A	353
Basket B	329
Basket C	294

Table 5 NAMC market basket comparison

Basket A: The cost of the market basket using the national average food prices

Basket B: The cost of the market basket if only shop within Avian Park (includes *spaza* shops, café in community and small supermarket in the community)

Basket C: The cost of the market basket if able to shop within Avian Park and Worcester Town (includes *spaza* shops, café in community, small supermarket in community, supermarkets and street vendors)

The total cost to obtain the NAMC Food Basket (Basket A), which is what the average South African adult purchases every month, is R353. This is compared to the two other baskets; basket B, which contains the lowest food prices of items only available within Avian Park, and basket C, which contains the lowest food prices of items available within Avian Park and the retail outlets available in town (Table 5). The cost of a market basket C is R59 (17%), less than the National Average Food prices. Residents would have to pay R35 (11%) more if they were not able to access the town with the supermarkets and street vendors with their competitive prices. The market basket also costs R37 more if only *spaza* shop prices are compared to the chain supermarket prices[17]. The residents would still be paying less than the national average for their food items. Limited food access is a context-specific problem for the community, due to the limited type of food items made available in the immediate food retail environment of Avian Park.

The cost of Basket B is compared to the per capita monthly household income (Table 6).

Table 6 Cost of Basket B compared to household income[18]

Proportion of households in community	Per capita income (R/month)	% of income (Basket B)	% of income (Basket C)
20%	316	N.A	93%
50%	1000	33%	29%
30%	1500	22%	20%

The calculations in Table 6 reveal that 20% of the households in Avian Park would not be able to afford a basket of food if they were only able to procure food from the immediate food retail environment (Basket B). If the cost of Basket C is taken, then the same proportion of the community would have to spend 93% of their monthly income to meet their basic dietary needs. Half of the households in Avian Park would have to spend 33% and 29% of their monthly income to obtain Basket B and C respectively. The remaining 30% of the households in Avian Park

[17]See Appendix B for the specific food items and prices included in the NAMC food basket.
[18]The household income figures are derived from a study done in Avian Park conducted by the Department of Sociology and Social Anthropology, Stellenbosch University in 2011 (118).

would only have to spend 22% and 20% of their monthly income to obtain the above mentioned food baskets.

5.4 Insight into the distribution system

The core findings of the research done through the semi-structured interviews are given and discussed below. This gives a deeper insight into the food retail environment of Avian Park and identifies the areas in the informal retail sector that can be improved. The detail of the data is presented in Appendix D.

5.4.1 Physical characteristics of the *spaza* shops

The physical characteristics of the *spaza* shops have an influence on the quantity, type and quality of food items that they can source. The majority of the *spaza* shops were located in a shack (54%) and 23% operated from a metal container. The owners and managers of these *spaza* shops reported that they have difficulty in storing fresh produce and meat, as the outlets heated up during the day and space for refrigerators or freezers was limited. The remaining *spaza* shops, included in the study, were located either inside a house (8%), in a brick outbuilding in a back yard (8%) or in a room attached to a main house (8%).

5.4.2 Purchasing procedures of the *spaza* shops

The purchasing methods of the chain supermarkets discussed in 3.4.1, p.25 were confirmed by the supermarket' managers included in the study. The chain supermarkets operated through a distribution center and they sourced their fresh produce from markets situated in Epping, Cape Town and Brackenfell.

All of the *spaza* shops (100%) procured processed and staple food items from a wholesaler and 46% also sourced items from supermarkets. *Spaza* shops mostly do not have links with product manufacturers and it was found that *Coca-cola* and *Sasko* were the only product manufacturers that delivered directly to *spaza* shops.

Most of the *spaza* shops (46%) sourced their fresh produce from a wholesaler. This is a different wholesaler from which the street vendors purchase their produce. Of these *spaza* shops that source their produce from the wholesaler, two also sourced fresh produce directly from a farmer. Three of the *spaza* shops (23%), included in the study, reported to source fresh produce from a chain supermarket and 31% of the *spaza* shops did not sell fresh produce.

There is one big fruit and vegetable wholesaler in the town of Worcester. The street vendors purchase their produce from this wholesaler and this enables them to sell a variety of fresh fruit and vegetables at lower prices compared to the *spaza* shops (see Figure 14, p.50). The *spaza* shop owners did not buy from this specific wholesaler, even though they got a wide variety of fresh produce available at competitive prices. The reasons that the *spaza* shop owners gave were the lack of cash flow to buy in bulk and transportation barriers. The wholesaler in town was reported to obtain the fresh produce from markets in Cape Town and farms in Ceres and Wolseley.

The *spaza* shop owners usually purchase fresh produce 1 to 3 times per week. For processed and staple food items it varied between the individual *spaza* shops, but 31% reported to do their shopping daily, which speaks of a very inefficient purchasing procedure.

Of the *spaza* shop owners interviewed, only 38% owned their own vehicle and 46% of the owners use a taxi to travel to the suppliers. The owners reported that the taxi prices are high and that they are unable to buy in bulk if they travel by taxi. The owners that mostly made use of the taxis were the ones that usually had to travel daily to buy stock. Two of the *spaza* shop owners (15%) reported to work together with other *spaza* shop owners. They have one car amongst each other and buy their stock in bulk. This enabled them to receive discounts at the suppliers and to ensure more competitive retail prices.

5.4.3 Local food

Of all the food retail outlets included in the study, only 16% (2 *spaza* shops and 2 butchers) reported to sell local food[19].

One of the *spaza* shop owners, who sold local food, reported that a local farmer delivers the fresh produce to the *spaza* shop. There is no formal contract between them, and the farmer delivers a variety of different fruit at unexpected times. The owner stated that the prices are good, but the produce is usually of low quality. The other *spaza* shop owner reportedly obtained his fresh produce from a local farm in De Doorns. The owners have to travel to the farm by their own means, as there is no formal delivery system, or procurement agreement in place. The owner reported that it is in general difficult to make contact with local farmers and access their produce.

[19]Local food refers to food that is produced and distributed within the borders of the Breede Valley Municipal Area. This includes Rawsonville, De Doorns and Touwsrivier (see Fig 34, Appendix B).

The two butchers in town, included in the study, source their products from a local chicken farm in De Doorns.

Apart from the chain supermarkets, all of the owners/managers of the different food retail outlets reported that they would sell more local food if there was a centrally-organised local distribution system in place. They also indicated that they would need the local food to be delivered. The main reasons for not selling local produce at the different food retail outlets were the unavailability and high prices of local food.

5.5 Chapter summary

The research findings were used to characterise the food retail environment of Avian Park. It was found that there is no chain supermarket situated in Avian Park and the food retail environment predominantly consists of *spaza* shops. The residents are also walking distance from a café and a small supermarket situated within the community.

Given the high availability of food items at the supermarkets (100%) and street vendors (78%) in town, it seems that limitations in the variety and quality of food items are the main disadvantages of having to rely only on the immediate food retail environment within the community. In the fresh fruit and vegetable category, the *spaza* shops sold mostly potatoes, onions and bananas, and the mark-up was high, yet the prices were still reasonably competitive, compared to the chain supermarkets. The café and the small supermarket in the community sold a better variety of fresh produce to the residents by selling butternut, green beans, cucumber and cabbage. It was found, however, that the prices for these items were higher compared to the street vendors in town.

The supermarkets in town generally had the most competitive prices for processed and staple food items. It is of concern to note that of the most frequently procured items, including coffee, rice and tea, the *spaza* shops had the highest prices. The community residents do not have a variety of fresh fruit or vegetables, nor fresh meat, available in their immediate food retail environment. The inefficient working of the *spaza* shops value chains and the lack of distribution of local food were also identified as areas that could be improved, to ensure a more sustainable and efficient local food system. The lack of local food distribution is considered to be one of the biggest problems from a nutrition point of view and from a food system perspective; it poses as a problem given that Avian Park is situated in a fruit producing area.

The food prices in Avian Park and the surrounding area are below the national average for all food categories except for breads, cereals and other grains as well as for sweets and sugars. The problem concerning food access in terms of affordability is more context-specific and not a regional problem. Community residents are limited in their access to a variety of nutritious food at the best prices, if the availability and price of food within the community is compared to the nearby town. Residents would have to pay R35 (11%) more if they were not able to access the town, with the higher variety of food retail outlets.

The research findings create insight into the food system of Avian Park and are used to build the system dynamics model presented in the next chapter. The main requirement in building a system dynamics model is an ample understanding of the interactions and dynamics of the real world system (119).

6. System Dynamics

6.1 Introduction

The research findings given in the previous chapter provides insight into parts of the food system of Avian Park. This information is used to build a system dynamics model for the food system of the community.

Forrester (120) introduced system dynamics as a modelling and simulation methodology. He initially applied this methodology in industrial management problems (54) and since then various studies have been done using system dynamics to analyse diverse dynamic problems (121).

System dynamics is a suitable approach when investigating food security and the food system (122,123). The "systems" perspective of system dynamics, bridges the barriers between different disciplines (54), which makes it possible to encompass the interdisciplinary nature of food security. Decisions that are made in complex environments end up destabilizing the very system that needs to be managed. System dynamics is an appropriate approach to better understand the complexity of the food system and to generate information that would enable more effective management of food security (121).

This chapter presents the fundamentals of system dynamics (section 6.2). A description of system dynamics models used in food security studies is then given (section 6.3). Finally, the model developed for a part of the food system of Avian Park is presented (section 6.4).

6.2 System dynamics fundamentals

System dynamics helps to understand the critical factors that lead to specific outcomes in a system. The interactions between the factors in the system are revealed and the analysis of this provides an understanding of the structural behaviour of a system (25). System dynamics is built on a mathematical foundation and is based on the theory of feedback control and nonlinear dynamics (121).

6.2.1 Feedback

The fundamental principal of system dynamics is the feedback process. All systems consist of dynamic networks of positive and negative feedback loops. Positive feedback loops reinforce

whatever is happening in the system (121). For example, the increase in births will increase the population of a given society. Births are seen as a cause, and population is an effect in system dynamics. When this scenario is investigated over time, it also becomes true that the population causally affects the number of births; the more people, the more births there will be. Not only does the increase in births increase the population, but the increase in population also increases the number of births; a circular causality is thus created (Figure 22).

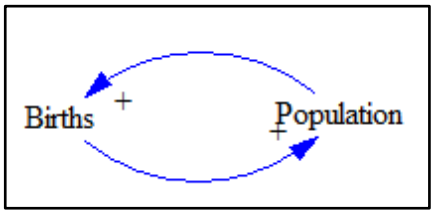


Figure 22 Positive feedback

Negative feedback loops counteract change (121). For example, as the number of deaths increase, the population will decrease (Figure 23).

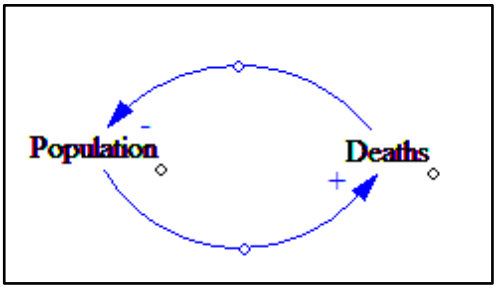


Figure 23 Negative feedback

The complexity and dynamics of a system lies in the interactions or feedback among the components of the system and not in the complexity of the components themselves (121). Feedback loops can be seen as the "engine" of change. Multiple loops create a more sophisticated engine and in turn the dynamics of the system becomes more complex (54). Causal loop diagrams are the tool used to illustrate the feedback structure of systems. It consists of the different variables in the system and is connected by arrows that symbolise the causal influences that the variables have on each other (121) (see Figure 25, p.69).

6.2.2 Nonlinear dynamics

The different variables in the system are in non-linear relationships with one another (124). This simply means that the relations between the variables are not proportional. The circular causality that is mentioned above is only possible dynamically; it requires time to pass. "Dynamic" means "changing over time" and dynamic problems must be continuously managed and monitored. The different variables in a system continuously undergo change over time and the structure of the system produce the dynamic behaviour patterns of the variables (54).

6.2.3 Stocks and flows

Apart from feedback and non-linear dynamics, stocks and flows are the other central idea in system dynamics theory. Causal loop diagrams as such are limited in the ability to capture the structure and dynamics of the system. Stock and flow diagrams are able to generate the information upon which decisions and policies concerning the system can be made (121) (Figure 24).

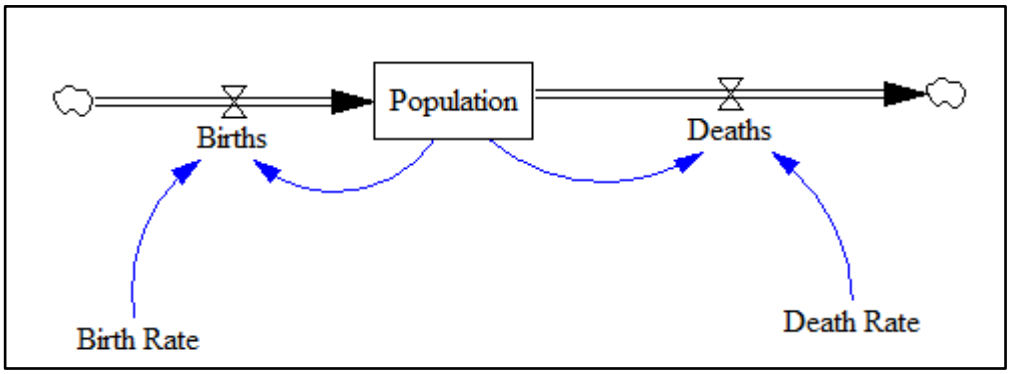


Figure 24 Stock and flow diagram

Stocks are called "states" as they represent the state of the system at a specific point in time (t) (121). In figure 24 "population" is regarded as stock. Flows (for example births and deaths, Figure 24) flow directly in and out of stocks and cause a change in the values of stocks. They are seen as the "rate of change" of stocks (54). A quantified model is built by providing numerical values for the drivers and equations for the relationships between the variables.

6.2.4 Mathematical representation of stocks and flows

The structure of system dynamics models consists of different variables and their relationship with each other (54). The relationship with each other is based on mathematical equations.

Mathematically the above model (Figure 24) states:

$$Pop(t) = Pop(0) + \int_0^t (births - deaths)dt \quad \text{....1}$$

Stock and flow diagrams consist out of an equation over time and the accumulation nature of the stock can be seen in the mathematical representation (54).

6.2.5 Simulation

Modelling is a common scientific tool used in investigating problems and can be defined as *"a representation of selected aspects of a real system with respect to some specific problem(s)."* (123). System dynamics models are descriptive models. These models describe how variables interact and generate the "as is" of a system. This stands in contrast to optimisation models which usually seek to derive the optimal solutions or the "should be" state (54).

"Simulation is a step-by-step operation of the model over compressed time" (54). The complexity of system dynamics models makes it impossible to mentally understand and grasp the system, and the possible implications of decisions or policies, concerning the specific system under investigation. Simulation is the only practical way to test and understand the models (121). The dynamics of the variables are obtained through running the model over compressed time (54).

Different scenarios are represented by running the model with different sets of inputs and the results indicate the system's behaviour (122). The structure of the system is described in terms of the relationships between the positive and the negative feedback loops (124).

6.3 System dynamics models in food security studies

There are several studies that used system dynamics in investigating food security and other related issues. The food availability system of Columbia was explored through the use of system dynamics modelling. The different scenarios that were tested through simulation revealed the

best way to respond to the threat of food insecurity and equipped decision makers to be more effective in their strategic planning for the country (123).

In another study a system dynamics approach was used as means of understanding the complexity of food security in developing countries. A partial model was developed to explore the availability of food, the access to food resources and the stability of food security on a national level. The model enabled the investigation of changes in food prices, population growth and land use under different scenarios (125).

Other studies focused on the tension between food security and energy security. A system dynamics model was built to analyse the global cereal and energy market and to forecast the global food production and stock of those markets (52). Another model was built that generated insights into the impact that bioenergy crop cultivation could have on global food security, a specific focus was placed on food prices and food shortages (126). The implications of expanding bioenergy programmes in South Africa were investigated by the development of a system dynamics model, to explore the dynamics of this industry. The model was applied to the case of biodiesel production in the Eastern Cape Province of South Africa. The model was simulated to investigate the baseline behaviour of biodiesel development and incorporated societal, economic and environmental dimensions of the province (127).

6.4 The System dynamics model developed for Avian Park

The software package, *Vensim*, was used to construct a system dynamics model, using selected aspects of the food system of Avian Park to study the dynamics in food availability and accessibility in the community. The concerns in the food system of Avian Park, discussed in the previous chapter, were brought together in this model.

The goal of the model is to provide technical information that local authorities could use in management and strategic planning, to ensure community food security (objective (iii)). This model aims to provide an understanding and an integrative view of the food system of Avian Park that serves as a lever on decision making.

6.4.1 Causal loop diagram for the developed model

Figure 25 provides an overview of the model structure. The causal loop diagram contains all the variables that play a potential role in creating the dynamics of concern in the food system of Avian Park.

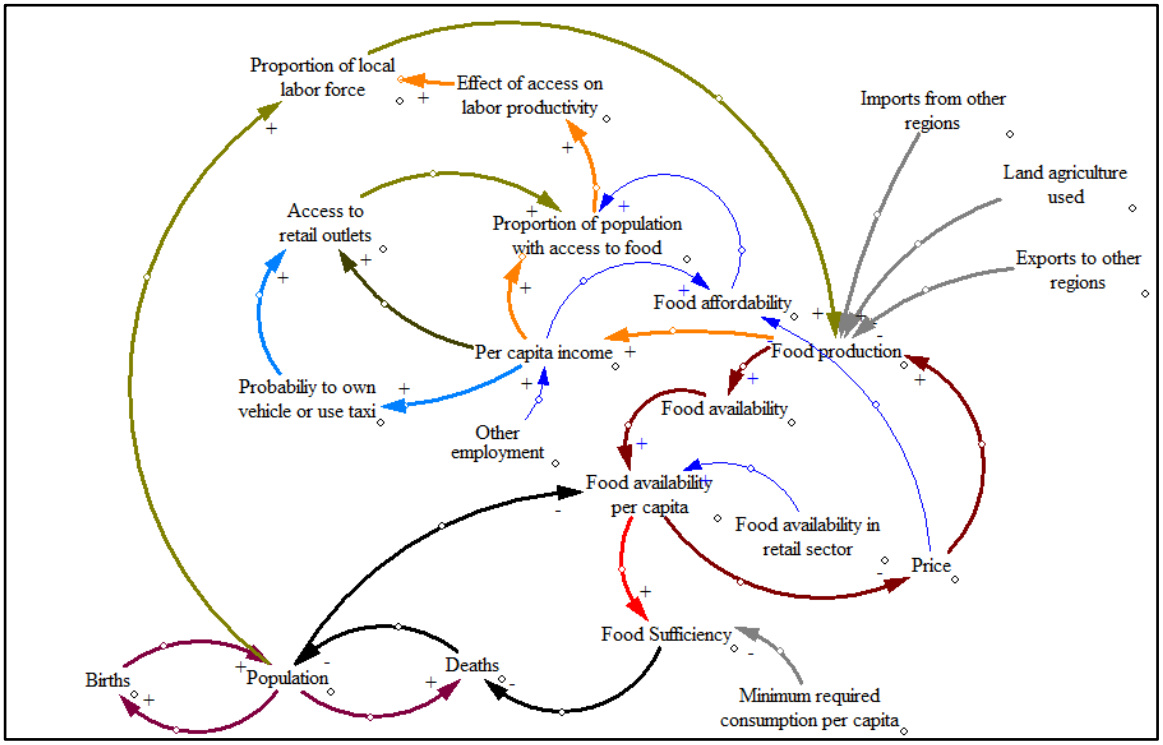


Figure 25 Causal loop diagram of model structure

The causal effects and feedback loops between the variables that determine food availability and accessibility in the community are illustrated in this figure. Food availability in Avian Park is dependent on the availability of food in the different food retail outlets and on the local production of food.

The figure further illustrates how the increase in food sufficiency would decrease the number of deaths in the community. This will lead to an increase in the population, which would decrease the food availability per capita and in turn decrease the food sufficiency. Food availability has an indirect effect on food prices and this has an effect on the proportion of the population which have access to food. Food access is also determined by the access to retail outlets which in turn is

influenced by the probability to own a vehicle or use a taxi. The price of food and income determines the affordability of food.

Figure 26 and Figure 27 provides a clearer visual illustration of the variables that causes food availability and food accessibility. The variables at the tale of the arrow cause the variable at the end of the arrow to change.

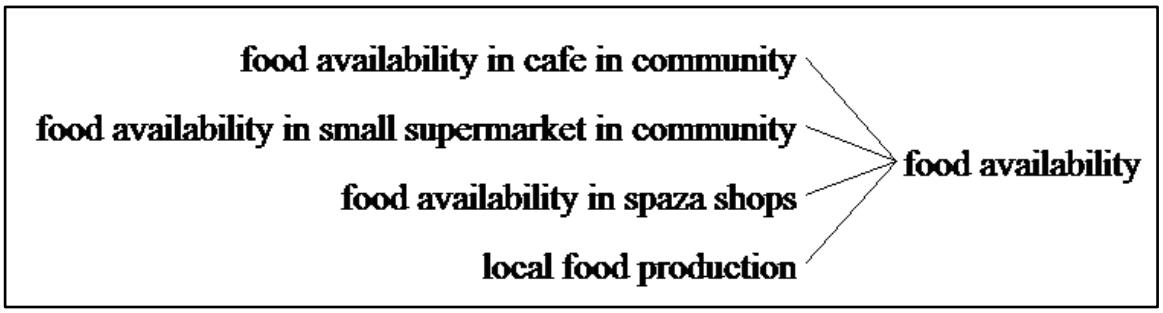


Figure 26 Variables that causes food availability

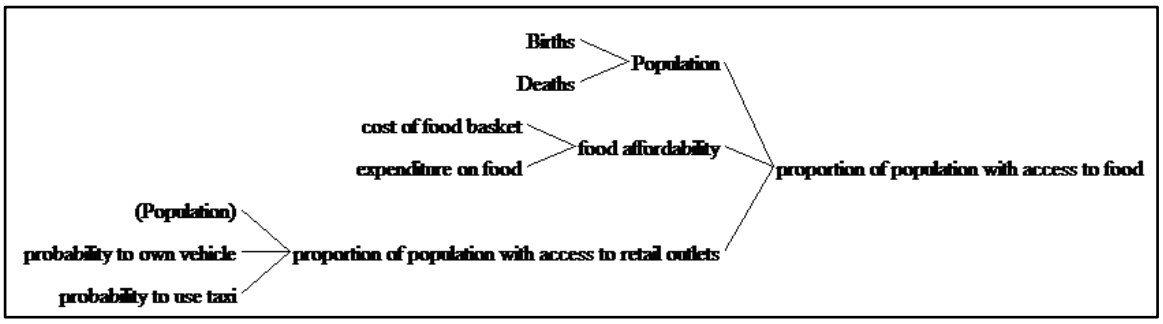


Figure 27 Variables that cause food accessibility

6.4.2 Stock and flow diagram for the developed model

The formal simulation model is built through constructing a stock-flow diagram; this is based on the causal loop diagram (Figure 25, p.69). Mathematical formulations that describe the cause-effect relations are given for all the variables in Appendix E.

Table 7 and Table 8 specify the key model parameters and the initial values of the variables. This is the setup for the model (Figure 28, p.72) for the baseline scenarios that is discussed in section 6.4.4, p.73.

Table 7 Model key parameters

Parameter	Value	Unit
Simulation Setup	2005	yr
Simulation Period	15	yr

Table 8 Model initial values

State Variable	Initial value	Unit
Population	10 000[20]	person
Birth rate	0.02	dmnl/yr
Cost of food basket	329	R/month
Death rate	0.01	dmnl/yr
Expenditure on food	0.37[21]	R/month
Food availability: café	18[22]	dmnl
Food availability: *spaza*	22[23]	dmnl
Food availability: small supermarket	23[24]	dmnl
Monthly wages	893[25]	R/month

[20] Breede Municipality population figure (114).
[21] Poorest income decile spends 37% of their income on food, based on the IES 2005/2006 (45).

[22] 18 out of 33 items included in the food basket (section 5.2.2, p. 43)
[23] 22 out of 33 items included in the food basket
[24] 23 out of 33 items included in the food basket
[25] Wages for farm workers (majority of residents are farm workers) (118).

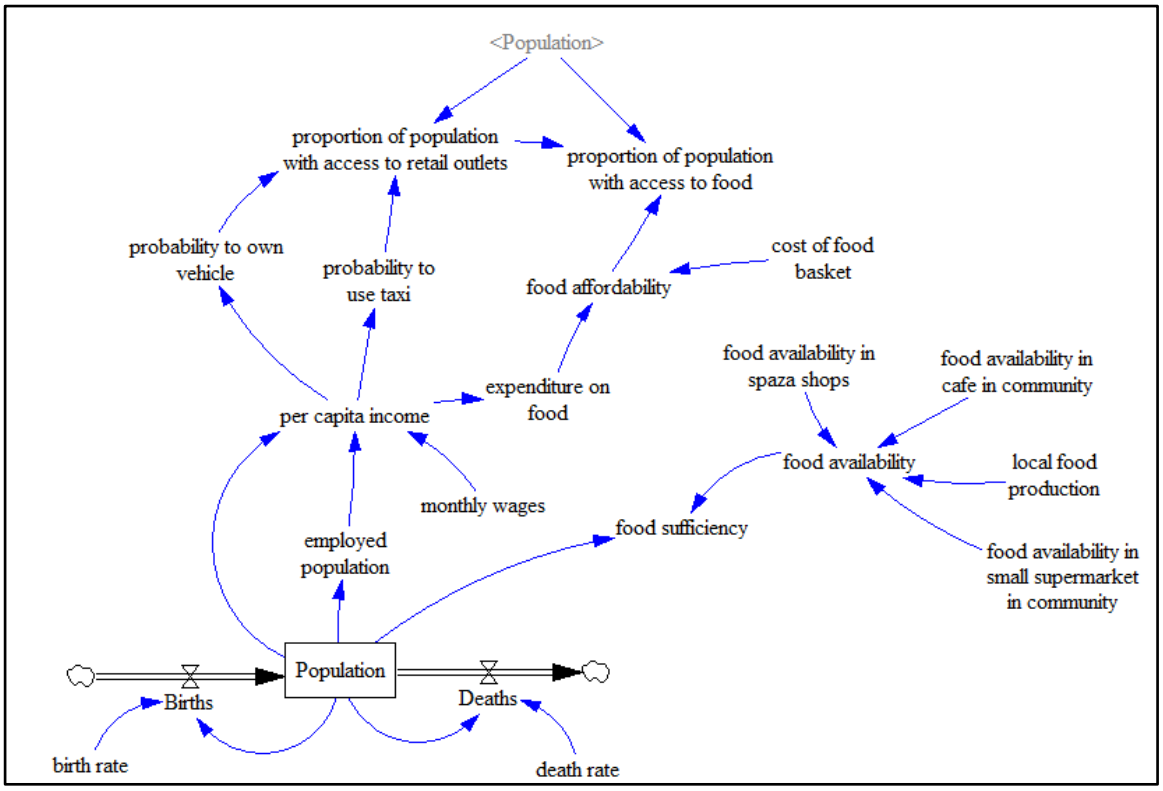


Figure 28 Stock and flow diagram for Avian Park

6.4.3 Model validation

System dynamics models are validated in a continuous process throughout the development of the model. The model is tested in each step of the development and according to the feedback, iterations are made. This is a way of building confidence in the structure of the model (121,128). Three tests were done to validate the model namely structural validity, dimensional consistency test and extreme condition test.

6.4.3.1 Structural validity

The internal structural validity is fundamental in the validation of the model (128). The validity of the internal structure of the model comes from the descriptive knowledge about the system structure (121). This can be tested by determining if the model matches the structure of the system in reality. Every model component must have a real world counterpart and every key factor that influences the real world problem should be included in the model (54). The structural validation process began with building an in-depth understanding of the system in reality through

the research findings in Chapter 5. The relationships between the different system variables were brought together in the causal loop diagram (Figure 25, p.69).

6.4.3.2 Dimensional consistency test

A dimensional consistency test is done to determine whether the equations in the model are dimensionally consistent. Constants are inserted in the model and simulated (121). The simulation using *Vensim* software did not generate any dimensional consistency errors.

6.4.3.3 Extreme condition test

Confidence in the model is built when it functions appropriately under extreme conditions. The model must be subjected to these conditions and the resulting behaviour is evaluated against what would be expected to occur in a real world system (119). A number of selected variables were assigned to extreme values and the output was observed to correlate what would be expected in a real world system (see Appendix E).

6.4.4 Simulation results

To investigate the structure of the system of Avian Park, four different simulations were run. This is presented and discussed in the following section. The outputs of the simulation runs provides quantitative data and an integrative view of the food system that could be used for better strategic planning to ensure greater food security. It also highlights areas of potential intervention to ensure greater food security in the food system of Avian Park.

6.4.4.1 Scenario 1 and Scenario 2

The first two scenarios (Scenario 1 and Scenario 2(i)) investigated the difference of the effect on food accessibility between strategies to improve the unemployment rate and strategies to ensure access to the most competitive food prices. The effect of rising food prices is further investigated in Scenario 2(ii). The interactions between the factors in the system are revealed and the analysis of this provides an understanding of the structural behaviour of a system (25).

Table 9 Scenario 1 inputs

	Unemployment rate
Baseline	0.22
Scenario 1	0.11

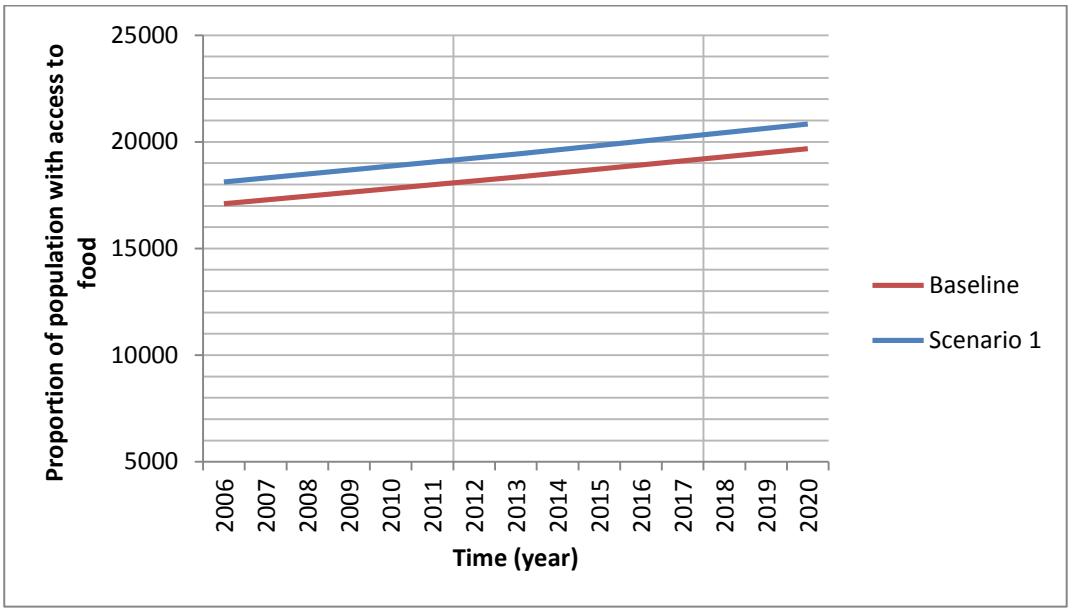


Figure 29 Scenario 1 output graph

It is clear from Figure 29 that the proportion of the population with access to food will increase if strategies to decrease the unemployment rate are successfully implemented. This is what would be expected, but this scenario is further investigated by comparing it to the results of scenario 2 (i).

Table 10 Scenario 2(i) inputs

	Cost of food basket
Baseline	329
Scenario 2 (i)	294

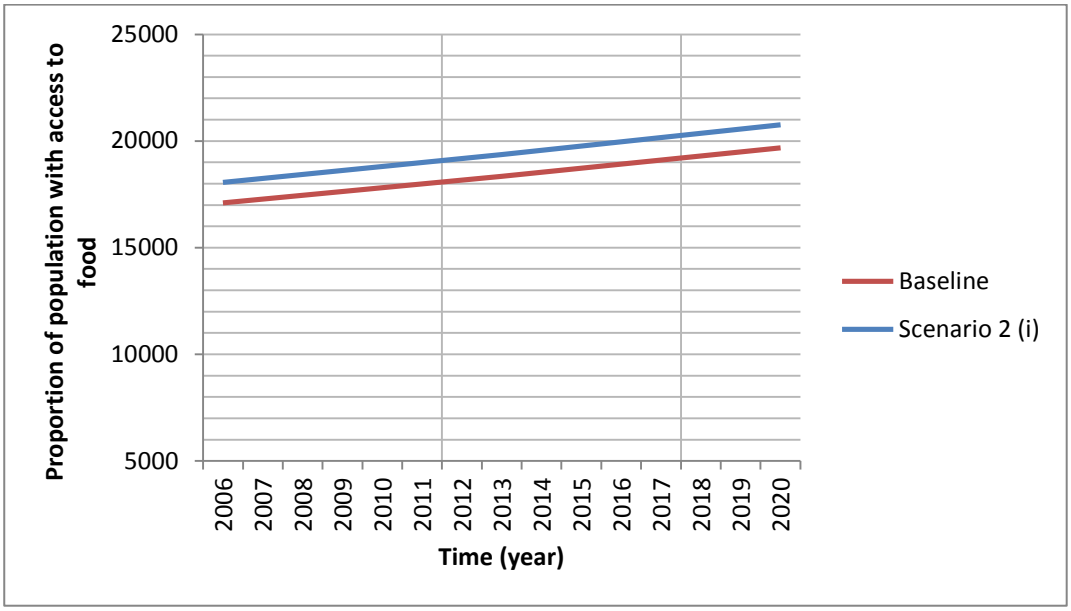


Figure 30 Scenario 2(i) output graph

The output for scenario 2 (i) seems very similar to scenario 1. Closer investigation reveals that decreasing the unemployment rate would have a slightly greater effect in the long term on food accessibility if compared to the effect of decreasing the cost of the food basket. In 2013, 65 more people would have access to food and this increased to 82 people in 2020 (Table 11, p.76).

Table 11 Proportion of population with access to food for scenario 2(i)

	2006	2013	2020
Baseline	17104	18344	19673
Scenario 1	18118	19432	20840
Scenario 2 (i)	18058	19367	20758

The baseline run represents the situation where the community only have access to the food in their immediate retail environment (Basket B, Table 5, p.58). Scenario 2(i) represents the case where all the residents have access to the most competitive prices within the community and in town (Basket C, Table 5, p.58). In the latter case 1023 and 1085 more residents would have access to food in 2013 and in 2020 respectively. It is clear that the accessibility to specific types of food retail outlets do have a noticeable effect on food accessibility.

Scenario 2 (ii) investigated what the effect of doubling the cost of a food basket would have on the proportion of the population with access to food.

Table 12 Scenario 2(ii) inputs

	Cost of food basket
Baseline	329
Scenario 2	758

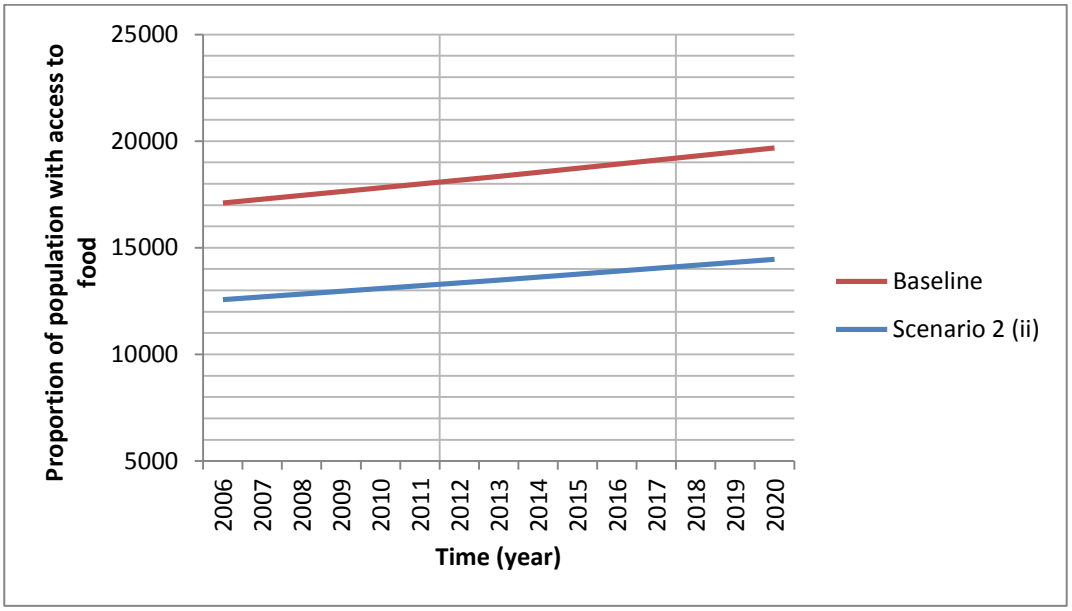


Figure 31 Scenario 2(ii) output graph

Figure 31 and Table 13 illustrates the severity of rising food prices. If food prices doubled then 4864 less people would have access to food in 2013 and 5216 less people would have access in 2020.

Table 13 Proportion of population with access to food for scenario 2(ii)

	2006	2013	2020
Baseline	17104	18344	19673
Scenario 2 (ii)	12569	13480	14457

6.4.4.2 Scenario 3

Scenario 3 investigated the overall effect on the proportion of the population with access to food by changing the key variables affecting food accessibility.

Table 14 Scenario 3 inputs

	Unemployment rate	Cost of Food Basket	Monthly Wages
Baseline	0.22	329	893
Scenario 3	0.11	294	1500

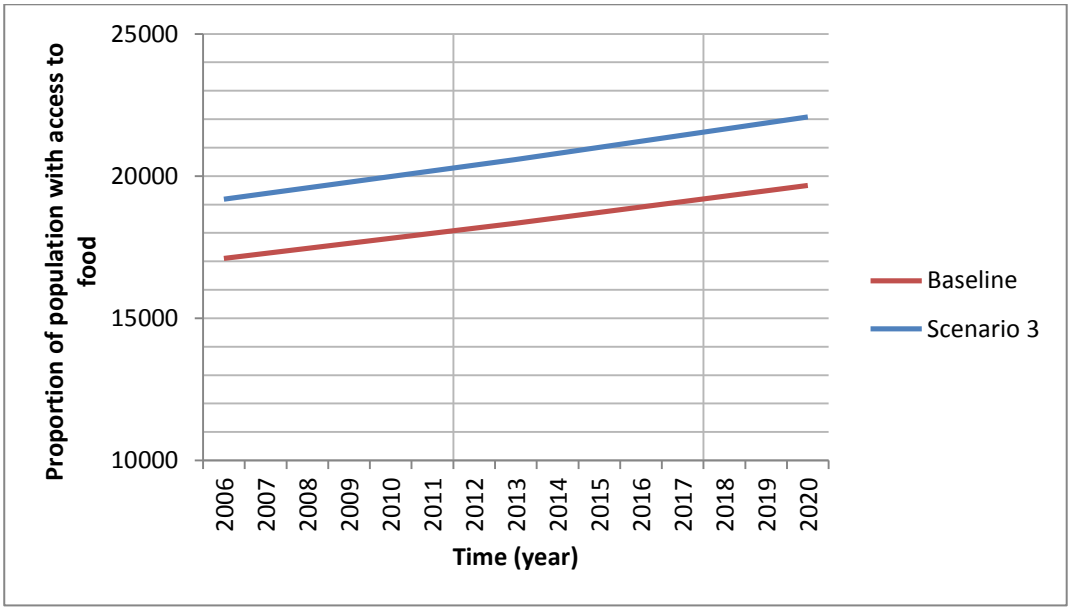


Figure 32 Scenario 3 output graph

Table 15 Proportion of population with access to food for scenario 3

	2006	2013	2020
Baseline	17104	18344	19673
Scenario 3	19191	20582	22074

The simulation output reveals that if these strategies were successfully implemented, it would have a positive effect on food accessibility. The proportion of the population that would have access to food would be 2238 and 2401more in 2013 and 2020 respectively.

6.4.4.3 Scenario 4

Scenario 4 investigated the effect of increasing the food availability by local food production.

Table 16 Scenario 4 inputs

	Food availability
Baseline	20
Scenario 4	33

In this context "food availability" refers to the variety and not quantity of foods available. The NAMC food basket (see Appendix B) was used to present the 33 food items that is needed for a nutritious diet. The food items made available by the different food retail outlets are added to determine what proportion of the food basket is available for the community.

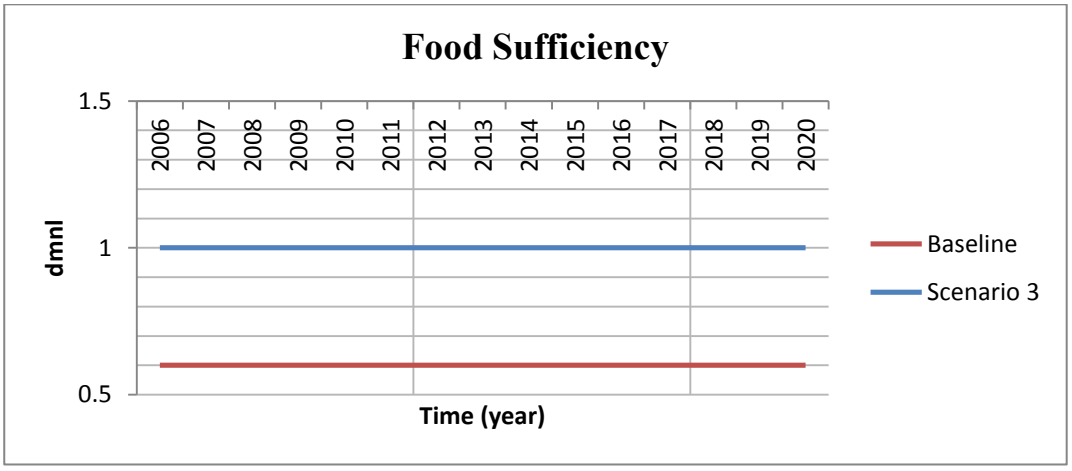


Figure 33 Scenario 4 output graph

Food sufficiency relates the difference between food availability and the minimum food required (123). Figure 33 reveals the situation where all the missing items from the food basket are filled through local production. This would ensure that the community can be classified as food sufficient (food sufficiency=1, see Appendix E).

6.5 Chapter summary

This chapter discussed the fundamentals of system dynamics and the concepts on which the approach is built. System dynamics is proven to be a relevant approach in food security studies. The multidisciplinary nature of the approach and its ability to manage complexity makes it useful in investigating the food system.

Furthermore, a system dynamics model was developed to identify those areas in the food system that needs attention in order to achieve greater food security in Avian Park. The aim of this model is to provide an understanding and an integrative view of the food system of Avian Park that serves as a lever on decision making.

Different simulations were run to investigate the effect of several strategies to increase food security. Apart from decreasing the unemployment rate and food prices, the results revealed that the accessibility to specific types of food retail outlets do have a noticeable effect on the proportion of population with access to food. If strategies to decrease unemployment rates, increase physical access to competitive food prices and increasing wages are successfully implemented, then 2238 more people would have access to food in 2013.

System dynamics is an appropriate approach to better understand the complexity of the food system and to generate information that would enable the management of food security to be done more effectively (121). The technical information presented in this chapter could be used by local authorities in the management of and development of strategic plans to ensure community food security. The way system dynamics can specifically empower local authorities in management and decision making are discussed in the next chapter. This is supported by suggesting specific strategies to improve community food security in Avian Park.

7. Managing Community Food Security

7.1 Introduction

Local authorities and municipalities can play a greater role in managing community food security. The results presented in the previous chapter provide information for local authorities to better manage and strategise community food security in Avian Park. System dynamics is proven to be an appropriate methodology for strategic decision-making (129). "*The aim of system dynamics is to provide managers with an understanding of the structure of complex systems so that they can intervene to ensure behaviour that fits with their goals*" (124).

This chapter firstly discusses the system dynamics approach in management (section 7.2). It is followed by the suggestion of different strategies to improve community food security in terms of food availability and accessibility (section 7.3), based on the findings of Chapter 6.

7.2 System dynamics approach in management

A systems approach is significant from the point of view of managers, as it assists them both in the achievement of their goals and the viability and adoption of specific policies (124, 125). System dynamics allows for continuous managerial actions and emphasizes a holistic approach in management thinking. When solutions, of complex problems, are focused on specific parts of the system, crucial interactions between the different parts are overlooked. Changes that are made in one part of a system may influence other parts and can damage the effective working of the system as a whole. Systems thinking managers are better equipped to cope with complexity, change and diversity.

The simulation of system dynamics models enables managers to identify those areas that need attention, in order to achieve maximum improvement and to reach specific objectives. An understanding of the feedback systems and the structural constraints within the system also enable managers to make effective decisions. They are then more aware of unintended consequences and are less likely to fall into the trap of treating the symptoms rather than the causes of dynamic problems (124).

7.3 Strategies to improve food availability and accessibility

The simulation of the system dynamics model identified those areas that need attention, to achieve optimal improvement, in terms of food availability and accessibility. Strategies to decrease unemployment and to increase wages are two fundamental approaches which create desired outcomes, but as discussed in section 3.1, p.18, it is important to move beyond this linear approach to food security.

Four managerial strategies are suggested to improve community food security in Avian Park. This includes strategies to develop *spaza* shops (section 7.3.1), transportation strategies (section 7.3.2), the management of different food retail outlet locations (section 7.3.3) and strategies to promote local food production and distribution (section 7.3.4).

7.3.1 *Spaza* shop development

Strategies to support *spaza* shops in their operations would strengthen the local economy within the community and result in competitive food prices for low-income consumers (13). Improving healthy food availability in *spaza* shops could also be an effective way to improve the food retail environment of the community.

It is suggested that investments should be made to upgrade *spaza* shops in terms of facility and equipment and to help local owners to develop their business skills. There are several managerial recommendations for *spaza* shop owners. They need to be equipped in activities like accounting, business finance, marketing, operations management and customer services. *Spaza* shops could provide employment opportunities if they managed themselves more efficiently and effectively (131).

Another strategy could be to organise *spaza* shops into a collective buying force in the form of business clusters. Co-operate buying schemes will enable owners to aggregate their purchasing power and thus obtain bulk buying benefits and discounts. It is also suggested that long term relations with suppliers should be fostered to obtain credit, discount and delivery. This will enable *spaza* shops to strengthen their business operations and to deliver better service to the community. Box 5 provides an example of an initiative to upgrade *spaza* shops in Soweto.

Box 5: Soweto franchisor aims to upgrade *spaza* shops

Basil Manganadelis is the owner of a small retail franchise, Walk-In 25. He has got 18 years of experience in running this franchise in Soweto. Basil wants to provide a "first-economy" shopping experience for the township residents and he is passionate about developing local economies. His frustration with the current reality that the poor actually pay more for their food than the rich motivated him to initiate the project to upgrade the existing *spaza* shops in the community.

Basil got a franchise model proposal, to upgrade 42 *spaza* shops in order that they could sell a higher variety of goods at lower prices. According to him there is big potential in providing quality stores within walking distance of township residents.

Basil's model involves the upgrading of *spaza* shops and also the possibility of co-operatives if *spaza* shop owners want to set up a store in conjunction with Walk-In 25. In his business plan he outlines that for R50 000, *spaza* shops can get a corporate redo, R15 000 worth of opening stock, a freezer, a fridge and a computer system. Walk-In 25 will ask a fee of 3-6% to provide services like centralized buying and delivery and administration. This initiative will ensure that *spaza* shops will be able to provide quality services to a key, untapped market (132).

7.3.2 Transportation strategies

The accessibility (to food) is determined by the ease with which a resident can access the services (type of food retail outlet) he or she needs or prefers (133).

For the residents who do not own their own vehicle, the extent, frequency and prices of public transport plays a pivotal role in food access. Vehicle ownership has significant implications for the type of food that residents can purchase. It is suggested that strategies providing transport vouchers (subsidies) to poor residents should be implemented.

7.3.3 Food retail outlet location management

The different food retail outlets can be seen as a proxy for food availability, price and quality. The store audit reveals that to locate chain supermarkets in the community would be the most effective way to ensure that the residents have access to a variety of food items at competitive

prices. Another strategy could be to locate more street vendors who sell fresh fruit and vegetables and a butcher within the community.

7.3.4 Local food production and distribution promotion

"*A food system cannot operate in an independent local vacuum, but is integrated within global systems*" (134). Yet, increasing local food production and distribution holds advantages and can increase community food security. A more locally based food system can contribute to the future integrity, sustainability and health of a community.

Strategies to connect farmers and consumers more directly should be implemented. As mentioned in section 3.3, p.22, some of the ways a direct link between producers and consumers are realized are through farmer's markets, public procurement initiatives, and community vegetable gardens.

There are no community vegetables gardens currently in Avian Park. There are, however, two vegetable gardens that are situated at local crèches within the community. The produce is mainly used for the crèche and is not available for other community residents. Some reasons for the lack of vegetable gardens in the community are; a general lack of interest in gardening, it (requires water, which is costly), goats and dogs in the community are destructive or the produce gets stolen. Residents do not want to have household gardens as they can ill-afford increased water bills.

As was revealed in the research findings in section 5.4.3, p.61 the different food retail outlet owners reported that they would sell more local food if there was a centrally-organised local distribution system in place.

7.4 Chapter summary

This chapter discussed the system dynamics approach in management. This approach equips managers to make more effective decisions and to develop strategies that would contribute most significantly to their objectives.

The suggested strategies are community-based solutions to improve community food security for Avian Park specifically. This could, however, also be used as general guidelines for managing food security of low-income communities in a similar context. As mentioned in section 1.1, p.1,

Avian Park is considered to be a good example of a typical lower socio-economic coloured community in the South African context.

8. Conclusions and Recommendations

8.1 Introduction

The purpose of this chapter is to provide a comprehensive research summary. It will be done by restating the research objectives and the research done to achieve them (section 8.2). It is followed by a summary of the main results (section 8.3), then concluding remarks will be given (section 8.4) and the research study ends with recommendations for future research (section 8.5).

8.2 Meeting the research objectives

The present food system is failing to serve the urban poor and low-income communities living in informal settlements often struggle to obtain a nutritious diet. To investigate this problem the following research objectives were obtained (Table 17):

Table 17 Restating the research objectives

Research objective (What?)	Research Conducted (How?)	Chapter
the modernised food system was investigated and it was determined how it contributes to the food security status of low-income communities	Systematic literature review	2
an understanding of the current status of the local food system in Avian Park, focusing on the local food distribution system (focusing on food availability and accessibility) was obtained	Empirical research	5
technical information was provided, which local authorities could use in management and strategic planning to ensure community food security	System dynamics modelling	6

8.3 Summary of the main results

The main results will be summarised under the headings of the three research objectives.

8.3.1 The modernised food system and community food security (objective (i))

The modernised food system contributes to the creation of food deserts which marginalises low-income communities in their access to a variety of nutritious food. In urban communities the food retail sector will determine the availability and accessibility of food.

The structure and dynamics of the food system and the variety of factors that lead to food insecurity makes this a more complex issue. The study suggests that planning frameworks and incentive systems in municipal areas could contribute to the food availability and accessibility of low-income communities.

8.3.2 Food availability and accessibility in Avian Park (objective (ii))

In Avian Park food prices are not the main factor that inhibits food accessibility. The problem lies more with the variety and quality of food that is made available in the food retail environment.

8.3.3 Technical information to manage community food security (objective (iii))

The research study revealed specific areas of intervention in the food system of Avian Park that could contribute to greater community food security:

- *Spaza* shop development
- Transportation strategies
- Food retail outlet location management
- Local food production and distribution promotion

Local governance could take up a more prominent role in community food security. Managing these areas more effectively would lead to greater food security in Avian Park. The lessons learned could also serve other local authorities in their regional planning and managing of community food security.

8.4 Concluding remarks

This research study contributes to internal objectives of the OSP of the University of Stellenbosch, by providing information that fits into the key national and international development themes. Furthermore, it serves as an example of research that is more relevant and active in society.

Increasing the financial status of community residents would not necessarily lead to healthier dietary choices. Ensuring community food security would not solve the problems in the current global food system. It will also not be able to replace government programs aimed at supporting the poor. However, as mentioned in the problem statement (section 1.2, p.2), if community food systems are developed systematically it can strengthen communities and regions and ultimately ensure food security. Local planning and managing of food systems is important and should link with the goal of reaching sustainable community food security.

8.5 Recommendations

As the study was conducted several areas were identified that has potential for future research:

- **Agricultural production**

  A recommendation for future research is to incorporate the food production sector when investigating community food security. This would be more relevant in rural communities, but even the lack thereof in urban communities also needs attention.

- **Local authorities**

  It is recommended that interviews with local authorities could provide insightful information into the workings of the food system of a community.

- **System dynamics model**

  The model presented in this study could be used as a basis for further development. It is recommended that the aspect of food availability in terms of quantity and population growth should also be included.

- **Job creation through the local food system**

  The food system could be investigated to determine what opportunities are presented to create more jobs and to improve wages for the members operating in the system.

- **Strategy implementation**

  The scope of this research did not allow for the implementation and evaluation of the suggested strategies given in Chapter 7. Future work can focus on the implementation of these strategies. The suggested strategies could also be tested through focus group discussions or interviews with relevant stakeholders. This would also be valuable for the further development of the system dynamics model.

9. References

(1) Food security initiative. [Internet]. 2011 [cited 2011 Nov 9]. Available from: http://blogs.sun.ac.za/fsi/.

(2) OSP sets internal objectives to tackle challenges. University Stellenbosch Kampusnuus 2009 [cited 2011 Nov 9]. Available from: http://www.sun.ac.za/NEWS/ekampusnuus/pdf/OSP/pages/p2.pdf/.

(3) Zhang X, Cheng J, Wu S. Evaluating community accessibility for sustainable regeneration: a conceptual framework. 5th International conference on responsive manufacturing - Green manufacturing; 2010. Ningbo. p.444-56.

(4) Schonfeldt HC, Gibson N, Vermeulen H. The possible impact of inflation on nutritionally vulnerable households in a developing country using South Africa as a case study. Nutr Bull. 2010; 35:254-67.

(5) Temple NJ, Steyn NP. The cost of a healthy diet: A South African Perspective. Nutr. 2011; 27(5):505-8.

(6) Tustin D, Strydom J. The potential impact of formal retail chains expansion strategies on retail township development in South Africa. S.A Bus Rev. 2006; 10(3):48-62.

(7) Greenberg S. Contesting the food system in South Africa: Issues and opportunities. Belville: PLAAS; 2010. 37 p. Report No.:4.

(8) Block D, Kouba J. A comparison of the availability and affordability of a market basket in two communities in the Chicago area. Pub Hlth Nutr. 2005; 9(7):837-45.

(9) Guy C, David G. Measuring physical access to 'healthy foods' in areas of socail deprivation: A case study in Cardiff. Intr J Ret Distr. 2004; 32(2):222-34.

10) Krukowski RA, West DS, Harvey-Berino J, Prewitt TE. Neighborhood impact on healthy food availability and pricing in food stores. Com Hlth. 2010; 35(3):315-20.

11) Morland K., Wing S, Diez-Roux A, Poole C. Neighborhood characteristics associated with the location of food stores and food service places. Am J Prev Med. 2002; 22:23-29.

12) Scheier LM. What is the hunger-obesity paradox? Am Diet Assc. 2005; 105(6):883-86.

13) Azuma AM, Gilliland S, Vallianatos M, Gottlieb R. Food access, availability and affordability in 3 Los Angeles communities. Prev Chr Dis. 2010; 7(2):1-9.

14) Battersby J. Urban food insecurity in Cape Town, South Africa: An alternative approach to food access. Dev SA. 2011; 28(4):545-61.

15) Pothukuchi K., Kaufman JL. Placing the food system in the urban agenda: The role of municipal institutions in food systems planning. Agr Hmn Val. 1999; 16:213-24.

16) Pothuhuchi K. Community food assessment: A first step in planning for community food security. J Pln Ed Rsch. 2004; 23:356-77.

17) Trade reforms and food security. Rome:Food and Agriculture Organisation (FAO); 2003. 313p.

18) Maxwell S, Frankenberger TR. Household food security: Concpets, indicators, measurements. New York:United Nations Children's Fund (UNICEF); 1992.

19) Report of the world food conference. New York:United Nations (UN); November 1975.

20) Weingartner L. The concept of food and nutrition security. In: Klennert K, editor. Achieving food and nutrition security. 3rd ed. Feldafing. InWent; 2009.

21) The state of food security in the world: Monitoring progress towards the World Food Summit and Millennium Development Goals. Rome:Food and Agriculture Organisation (FAO); 2003.

22) Labadarios D, Davids YD, Mchiza Z, Weir-Smith G. The Assessment of food insecurity in South Africa. 2009. 49 p.

23) Negin J, Remans R, Karuti S, Fanzo JC. Integrating a broader notion of food security and gender empowerment into the African green revolution. Springer science and business media B.V. and International society for plant pathology. 2009. doi:10.1007/s12571-009-0025-z.

24) Hart T. Food security definitions, measurements and recent initiatives in South Africa and Southern Africa. Human Science Research Council (HSRC); 2009. 52 p.

25) Ericksen PJ. Conceptualizing food systems for global environmental change research. Glbl Environ Chg. 2008; 18(1):234-45.

26) Suresh CB, Sanyal P. Food Security, poverty and nutrition policy analysis. Burlington: Elsevier; 2009.

27) The state of food security in the world: How does international price volatility affect domestic economies and food security. Rome: Food and Agriculture Organisation (FAO); 2011. 62 p.

28) The state of food and agriculture: Women in agriculture. Rome: Food and Agriculture Organisation (FAO); 2011. 160 p.

29) Global hunger map [image on internet]. 2011 [cited 2011 Oct 11]. Available from: http://documents.wfp.org/stellent/groups/public/documents/liason offices/wfp185786.jpg.

30) The state of food insecurity in the world. Rome: Food and Agriculture Organisation (FAO); 2001.

31) Knight L, editor. World disasters report: focus on hunger and malnutrition. Geneva: International Federation of Red Crescent Societies; 2011. 250 p.

32) The state of food insecurity in the world: Economic crisis- Impacts and lessons learned. Rome: Food and Agriculture Organisation (FAO); 2009. 61 p.

33) Scherr S. Soil degradation: a threat to developing-country food security by 2020? Washington: International Food Policy Research Institute (IFPRI); 1999. 71 p.

34) Pretty JN, Ball AS, Lang T, Morison JIL. Farm costs and food miles: An assessment of the full cost of the UK weekly food basket. Food Plcy. 2005; 30(1):1-19.

35) Mkhabela T. Linking farmers with markets in rural South Africa: Rural development and poverty alleviation through supply chain management. Pretoria.

36) Weatherspoon D, Neven D, Katjiuongua HB, Fotsin R, Reardon T. Battle of the supermarket supply chains in Sub-Saharan Africa: Challenges and opportunities for agrifood suppliers. Proceedings of the United Nations Conference on Trade and Development; 2004 Dec 4.

37) The state of food insecurity in the world: High food prices and food security-threats and opportunities. Rome: Food and Agriculture Organisation (FAO); 2008. 44 p.

38) Von Braun J. The world food situation: New driving forces and required actions. Washington: International Food Policy Research Institute (IFPRI); 2007.

39) Eide WB, Kracht U. Food and human rights in development. Antwerpen: Intersentia; 2005.

40) Responding to global food price volatility and its impact on food security. Development Committee; 2011 April. 39 p. Report No.: DC2011-0002.

41) Patel R. Stuffed and starved: From farm to fork, the hidden battle for the world food system. London: Portobello Books; 2007.

42) Altman M, Hart T, Jacobs P. Food security in South Africa. Human Science Research Council (HSRC); 2009. 29 p.

43) Aliber M. Exploring Statistics South Africa's national household surveys as sources of information about household-level food security. Agrekon. 2009; 48(4):384-409.

44) Frayne B, Pendleton W. The state of urban food insecurity in Southern Africa. African Food Security Urban Network (AFSUN): 2010. 55 p. (with contributions from Crush J, Acquah B, Battersby-Lennard J, et al.

45) Jacobs PT. The Status of household food security targets in South Africa. Agrekon. 2009; 48(4):410-33.

46) Schonfeldt HC, Gibson N, Vermeulen H. The possible impact of inflation on nutritionally vulnerable households in a developing country using South Africa as a case study. Nutr Bull. 2010; 35:254-67.

47) Labadarios D, Swart R, Maunder EMW et al. Executive summary of the National Food Consumption Survey Fortification Baseline (NFCS-FB-I) South Africa. SA J Clinc Nutr. 2008; 21(3): 247-300.

48) Shisana O, Simbayi L, Rehle T, Zungu NP, Zuma K., Ngogo N. South African national HIV prevalence, incidence, behaviour and communication survey: A turning tide among teenagers? Cape Town: Human Science Research Council (HSRC); 2009. 120 p.

49) Vogel C, Smith J. The politics of scarcity: Conceptualising the current food security crisis in Southern Africa. SA J Science. 2002; 98(8):315-7.

50) Jacobs PT. Household food insecurity, rapid food price inflation and the economic downturn. Agenda: Emp Women for Gend Eq. 2010; 86:38-51.

51) Kinsey JD. The new food economy: Consumers, farms, pharms, and science. Am J Agric Econ. 2001; 83(5):1113–30.

52) Kim GR. Analysis of global food market and food-energy price links-based on system dynamics approach. Proceedings of the 27th International Conference of the System Dynamics Society; 2009, Albuquerque.

53) Battersby J. Urban food insecurity in Cape Town, South Africa: An alternative approach to food access. Dev Southern Africa. 2011; 28(4): 545-61.

54) Barlas Y. System Dynamics: Systematic feedback modeling for policy analysis. System Dynamics. n.d. 1:1-9.

55) Wheelock V. The food revolution. Bucks: Chalcombe Publications; 1986.

56) Webster K. The scope and structure of the food supply chain. In: Sharples L, Ball SD, Eastham JF, editors. Food supply chain management. Burlington. Elsevier; 2001.

57) Tansey G, Worsley T. The food system. London: Earthscan; 1995.

58) Beer S. Food and society. In: Sharples L, Ball SD, Eastham JF, editors. Food supply chain management. Burlington. Elsevier; 2001.

59) Lang T, Heasman M. Food Wars. London: Earthscan; 2004.

60) Seth A, Randall G. The Grocers. London: Kogan Page; 1999.

61) Jones A. Eating Oil. London: Sustain and Elm research centre; 2001. 5 p.

62) Clapp J, Fuchs D. Corporate power in global agrifood governance. Cambridge: The MIT Press; 2009.

63) Hendrickson M, Heffernan WD, Howard PH, Heffernan JB. Consolidation in food retailing and dairy: Implications for farmers and consumers. Columbia: National Farmers Union; 2001.

64) Norberg-Hodge H. The case for local food. [Internet]. 2010 [cited 2011 March 7]. Available from: www.isec.org.

65) Vermeulen H, Bienabe E. What about the food 'quality turn' in South Africa? Focus on the organic movement development. Paper presented at: The 105th EAAE Seminar 'International Marketing and International Trade of Quality Food Products'; 2007 March 8-10; Bolonga, Italy.

66) Feenstra GW. Local food systems and sustainable communities. Am J Alternative Agric. 1997; 1291:28-36.

67) Cross M, What if...Government bought green? [Internet]. 2009 [cited 2010 Oct 12]. Available from: http://www.theecologist.org/trial_investigations/286437/what_if_government_bought_green.html .

68) Mckibben B. Deep Economy: The wealth of communities and the durable future. New York: Time Books; 2007.

69) Schulschenk J. Benefits and limitations of local food economies to promote sustainability: A Stellenbosch case study [MsC thesis]. Stellenbosch: Stellenbosch University; 2010.

70) Haysom G. The food system in the Stellenbosch regions is simply not sustainable. Cape Times. 2011 Oct 19: Sect. Insight 11.

71) Field S, Masakure O, Henson S. Rethinking localization a low-income country perspective: the case of Asian vegetables from Ghana. Cam J Reg Econ Soc. 2010; 3:261–77.

72) Allen P. Realizing justice in local food systems. Cam J Reg Econ Soc. 2010; 3:295-308.

73) Hinrichs C. The practice and politics of food system localization. J Rural Stud. 2003; 19:33-45.

74) Dupuis E, Goodman D. Should we go "home" to eat?: toward a reflexive politics of localism. J Rural Stud. 2005; 21:359-71.

75) Cilliers P. What can we learn from a theory of complexity? Emergence. 2000; 2(1):23-33.

76) MacNair E. A Baseline assessment of food security in British Columbia's capital region. CR Fair; 2004. 38 p.

77) Fearne A, Hughes D, Duffy R. Concepts of collaboration: supply chain management in a global food industry. In: Sharples JF, Ball L, Eastham SD, editors. Food supply chain management. Burlington. Elsevier; 2001.

78) Minten B, Reardon T, Sutradhar R. Food prices and modern retail: The Case of Delhi. World Develop. 2009; 38(12):1775-87.

79) D' Haese M, Van Huylenbroeck G. The rise of supermarkets and changing expenditure patterns of poor rural households case study in the Transkei area, South Africa. Food Plcy. 2005; 30:97-113.

80) Ho S. Evolution versus tradition in marketing systems: The Hong Kong food-retailing experience. J Publ Plcy Mrktg. 2005; 24(1):90-99.

81) Reardon T, Hopkins R. The supermarket revolution in developing countries:Policies to address emergin tensions among supermarkets, suppliers and traditional retailers. Eurp J Dev Res. 2006; 18(4):522-45.

82) Weatherspoon DD, Reardon T. The rise of supermarkets in Africa: Implications for agrifood systems and the rural poor. Dev Plcy Rev. 2003; 21(3):335-55.

83) Pimbert M. Towards food sovereignty: reclaiming autonomous food systems. London: IIED; 2008. 24 p.

84) Hamm WM, Bellows AC. Community food security: Background and future directions. J Nutr Edu Bhvr. 2003; (35):37-43.

85) Cohen B. Community food security assessment toolkit. Food assistance and nutrition research program. USDA; 2002.

86) Review of changes in industrial structure and competition: Input paper for 15 year review. Policy and research division of the competition comission; 2008.

87) Ligthelm AA, Profile of informal microenterprises in the retail sector of South Africa. SA Bus J. 2004; 8(1):39-52.

88) Cole-Hamilton I, Lang T. Tightening Belts: A Report of the impact of poverty on food. London: London Food Commission; 1986.

89) Reisig V, Hobbiss A. Food deserts and how to tackle item: a study of one city's approach. Hlth Edu J. 2000; 59:138.

90) Wrigley N. Food deserts' in British cities: policy context and research priorities. Urban Stdy. 2002; 39:2029–40.

91) Morland K, Wing S, Diez Roux A. The contextual effect of the local food environment on residents' diets: the Atherosclerosis risk in communities (ARIC) study. Am J Pub Hlth. 2002; 92:1761-67.

92) Powell L, Slater S, Mirtchera D, Bao Y, Chaloupka F. Food store availability and neighbourhood characteristics in the US. Prev Med. 2006; 44:189-95.

93) Darmon N, Drewnowski A. Does social class predict diet quality? Clinical Nutr. 2008; 87:1107-17.

94) Jetter KM, Cassady DL. The availability and cost of healthier food alternatives. Am J Prev Med. 2006; 30:38-44.

95) Ford PB, Dzewaltowski, DA. Disparities in obesity prevalence due to variation in the retail food environment: three testable hypotheses. Nutr Rev. 2008; 66:216-28.

96) Jayne T. Forces of change affecting African food markets: Implications for public policy. In: Pingali E, Stamoulis P, Mccullough K., editors. The transformation of agri-food systems: Globalization, supply chains and smallholder farmers. Rome. FAO; 2008.

97) Mayer RN, Scammon DL. In Urban Areas: Many of the poor still pay more for food. J Pub Plcy Mrkt. 1993; 12(2):268-75.

98) Tustin D, Strydom J. The potential impact of formal retail chains' expansion strategies on retail township development in South Africa. SA Bus Rev. 2006; 10(3):48-62.

99) Chung C, Myers SL. Do the poor pay more for food? An analysis of grocery store availability and food price disparities. J Cons Affairs. 1999; 33(2):276-96.

100) Popkin B, Duffey K, Gordon-Larsen P. Environmental influences of food choice, physical activity and energy balance. Physio & Bhvr. 2005; 86:603-13.

101) Edmonds J, Baranowski T, Baranowski J, Cullen KW, Myres D. Ecological and socioeconomic correlates of fruit, juice, and vegetable consumption among African-American boys. Prev Med. 2001; 32:476-81.

102) Morland K., Diez Roux AV, Wing S. Supermarkets, other food stores, and obesity: the Atherosclerosis risk in communities study. Am J Prev Med. 2006; 30(4):333-39.

103) Whelan A, Wrigley N, Warm D, Connings. Life in a "Food Desert". Urb Stud. 2002; 39(11):2083-100.

104) Latham J, Moffat J. Determinants of variation in food cost and availability in two socioeconomically contrasting neighbourhoods of Hamilton,Ontario, Canada. Hlth & Plce. 2007; 13:273-87.

105) Liese AD, Weis KE, Pluto D, Smith E, Lawson A. Food store types, availability, and cost of foods in a rural environment. J Am Dietic Assc. 2007; 107:1916-23.

106) Cummins S, MacIntyre S. A systematic study of an urban foodscape: The price and availability of food in greater Glasgow. Urbn Stud. 2002; 39(11):2115-30.

107) Sheldon M, Gans KM, Tai R, George T, Lawson E. Availability, affordability, and accessibility of a healthful diet in a low-income community, Central Falls, Rhode Island, 2007-2008. Prev Chrnc Dis. 2010; 7(2):1-7.

108) Hayes R. Do the poor pay more? An empirical investigation of price dispersion in food retailing; 2002. 46 p.

109) Horowitz CR, Colson KA, Hebert PL, Lancaster K. Barriers to buying healthy foods for people with diabetes: Evidence of environmental disparities. Am J Pub Hlth. 2004; 94:1549-54.

110) Lloyd S, Lawton J, Caraher M, Singh G, Horsley K, Mussa F. A tale of two localities: Healthy eating on a restricted income. Hlth Ed J. 2011; 70(1):48-56.

111) Burns CM, Gibbon P, Boak R, Baudinette S, Dunbar JA. Food cost and availability in rural setting in Australia. Rural & Remote Hlth. 2004; 4(311).

112) Minten B, Reardon T. Food prices, quality and quality's pricing in supermarkets versus traditional markets in developing countries. Rev Agric Econ. 2008; 30(3):480-490.

113) Breede Valley Municipality Spatial Development Framework. Cape Town: Macroplan Town and Regional Planners; 2002.

114) Breede valley Municipality. Integreated development plan 2007 - 2011. 2007.

115) Mouton J. How to succeed in your Master's and Doctoral Studies. Pretoria: Van Schaik Publishers; 2009.

116) Ligthelm AA. Characteristics of spaza retailers: Evidence from a national survey. Pretoria: Bureau of Market Research; 2002.

117) Neven D, Reardon T, Chege J, Wang H. Supermarkets and consumers in Africa: The case of Nairobi, Kenya. East Lansing, Michigan: Department of Agricultural Economics, Michigan State University; 2005.

118) Heinecken L, Vorster J, du Plessis J. Socio-economic and social capital assessment of Avian Park residents, Worcester. Stellenbosch: Department of Sociology and Social Anthropology, Stellenbosch University; 2010.

119) System dynamics society website [Internet] [Cited 2011 Nov 13]. Available from: http://www.systemdynamics.org/.
120) Forrester JW. Industrial Dynamics. Cambridge: MIT Press; 1961.

121) Sternman JD. Business Dynamics: Systems thinking and modeling for a complex world. New York: McGraw-Hill; 2000.

122) Muetzefeldt R. Extended system dynamics modelling of the impacts of food system drivers on food security, livelihoods and the environment. CCAFS; 2010. 26 p.

123) Giraldo DP, Betancur MJ, Arango S. Effects of food availability policies on national food security: Colombian case. Paper presented at: The 29th International Conference of the System Dynamics Society; 2011, Washington.

124) Jackson MC. Systems thinking: Creative Holism for Managers. Chichester: John Wiley & Sons Ltd; 2003.

125) Giraldo DP, Betancur MJ, Arango S. Food security in development countries: A systemic perspective. Paper presented at: The 2008 International Conference of the System Dynamics Society; 2008, Athens.

126) Pruyt E, De Sitter G. 'Food or energy?' Is that the question? Paper presented at: The 2008 International Conference of the System Dynamics Society; 2008. Athens.

127) Musango JK, Amigun B, Brent AC. Understanding the implication of investing in biodiesel production in South Africa: a system dynamics approach. In: The 28th International Conference of the System Dynamics Society; 2010. Seoul.
128) Qudrat-ullah H, Seong BS. How to do structural validity of a system dynamics type of simulation model: the case of an energy policy model. Energ Plcy. 2010; 38:2216-24.

129) Georgiadis P, Vlachos D, Iakovou E. A system dynamics modeling framework for the strategic supply chain management of food chains. J Food Eng. 2005; 70:351-64.

130) Bear M., Bradnum P, Tladi S, Pedro D. Making retail markets work for the poor. Washington; 2005.

131) Perks S. Exploring the management abilities of spaza shop owners in the Nelson Mandela Metropolitan municipality. SAJEMS NS; 2010:447-63.

132) Crotty A, Soweto franchisor aims to upgrade spaza shops. Cape Times. 2011 Oct 13: Sect. Business Report:15.

133) DFT. Technical guidance on accessibility planning in local transport plans; 2006.

134) Bellows AC, Hamm MW. Local autonomy and sustainable development: Testing import substitution in localizing food systems. Agric Hmn Val. 2001; 18:281.

135) Food price monitor August 2011. Pretoria: NAMC; 2011.

Appendix A: Food Store Survey

i) Food store survey: Quantitative data collection

Store number (ID): _____

Food item	**Available (Yes / No)**	**Price / g**	**Source**
Fresh fruit and vegetables			
Apples			
Banana			
Sweet Potato			
Oranges			
Carrots			
Celery			
Green pepper			
Lettuce			
Onions			
Potatoes			
Cabbage			
Tomatoes			
Broccoli			
Pumpkin			
Green beans			
Breads, cereals, other grains			
Bread – white			
Bread – brown			
Bread – whole wheat			
Ready-to-eat-cereals (*Wheatbix*)			
Oats (uncooked)			
Rice			
Maize meal			
Wheat Flour			

Cake Flour			
Samp			
Dairy products			
Milk – full cream			
Milk – low fat / 2%			
Milk – fat free			
Meat and meat alternates - fresh			
Chicken- whole			
Chicken- feet			
Chicken- head			
Chicken-Offal			
Chicken – boneless, skinless			
Pork			
Polonies			
Wors			
Fish (snoek)			
Tuna fish – canned			
Pilchards in tomato sauce			
Beans – baked, canned			
Beans, dried			
Samp and beans			
Eggs			
Fats and oils			
Margarine			
Sunflower Oil			
Butter			
Peanut Butter			
Sugars and sweets			
Sugar – brown			
Sugar – white			
Salt			
Cold drink, carbonated			

(*Coca Cola*, *Double O*)			
Fruit Gums			
Toffees			
Chips			
Marie Cookies			
Tea			
Coffee			

ii) Food Store Survey (Semi-structured interview): Qualitative data collection

Greetings

Thank you for giving up your time to participate in this survey.
I am going to ask you some questions about your food retail outlet.
Please understand that your answers are completely
confidential and remember that there is no right or wrong answer.

1. Name of Retail Outlet: _____ Date:_____

2. Person Completing Survey: [ ] Owner [ ] Manager

PROFILE OF OWNER

3. Nationality of owner:_____
4. Gender of owner:_____
5. Age: _____

RETAIL OUTLET FACILITY

6. Store type classified by manager_____

7. i) What is the business structure of the food retail outlet?

a) *Spaza* shop	
b) Supermarket	
c) Street Vendor	
d) Cafe	
e) Butcher	
f) Wholesaler	
g) Other	

If a) answer question 8. i) :

8. i) Type of *spaza* shop accommodation:

a) Inside a house	
b) Room/garage attached to main house	
c) Brick building in back yard	
d) Metal container	
e) Shack	
f) Other (Specify)	

If b) answer 8. ii)

8. ii) What is the square meter of the store?_____

PURCHASING PROCEDURE

9. From what type of supplier do you purchase? (Specify the name).

a) Producer

b) Wholesaler

c) Hawker

d) Supermarket/Hypermarket

e) Other (Specify)

10. Indicate frequency of purchases:

a) Once a week

b) 2x a week

c) 3x a week

d) More than 3x a week

11. Indicate the method which is used most frequently to purchase merchandise from suppliers?
    a) Own transport
    b) Delivered by suppliers
    c) Hired transport
    d) Taxi
    e) Other (specific)

12. Are there any barriers to product provision?

13. What product is most frequently sold in this shop?

LOCAL FOOD

14. Does your store currently sell any local food? [ ] YES **(continue)** [ ] NO **(skip to c.)**

    a) From whom do you purchase local food?_____

    b) Do they deliver or must you pick up the food? _____

If No start here (if yes, continue):

c) Would you buy [any or more] local food if there were a centrally-organized local distribution system? [ ] YES [ ] NO

d) Would you need your local food delivered? [ ] YES [ ] NO

15. What do you believe are some of the **obstacles** to selling locally grown food at your store? (check all that apply)

[] affordability [] patrons choice [] storage capacity
[] availability [] liability/product insurance [] presentation of food
[] quantity [] convenience [] facility procurement policy
[] quality [] lack of distribution system [] inadequate receipts from producer
[] legal requirements

[] Other_____

_____

GENERAL

16. Do you have any comments, questions, or concerns that you would like to add?

_____

_____

_____

CLOSING

Thank you for sharing your time to answer these questions. We know you are busy and appreciate you taking the time to tell us about your experience and thoughts.

Community Food Security means that all people in the community at all times have access to safe, healthy, and affordable food through a sustainable food system.

Local food refers to food that is produced and distributed within the borders of the Breede Valley Municipal Area. This includes Rawsonville, De Doorns, Touwsrivier (**Error! eference source not found.**)

***Spaza* Shop** is defined as a shop or business operating in a section of an occupied residential home or in any other structure on a stand in a formal or informal township which is used for residential purposes and where people live permanently

Supermarket is defined a self-service store handling predominantly food and drug fast moving consumer goods (FMGD) with at least 150m^2 of floor space

Food Street Vendor is defined as a person who offers a limited amount of foods for sale with a temporary static structure or mobile stall usually occupying space on the pavements or other public areas

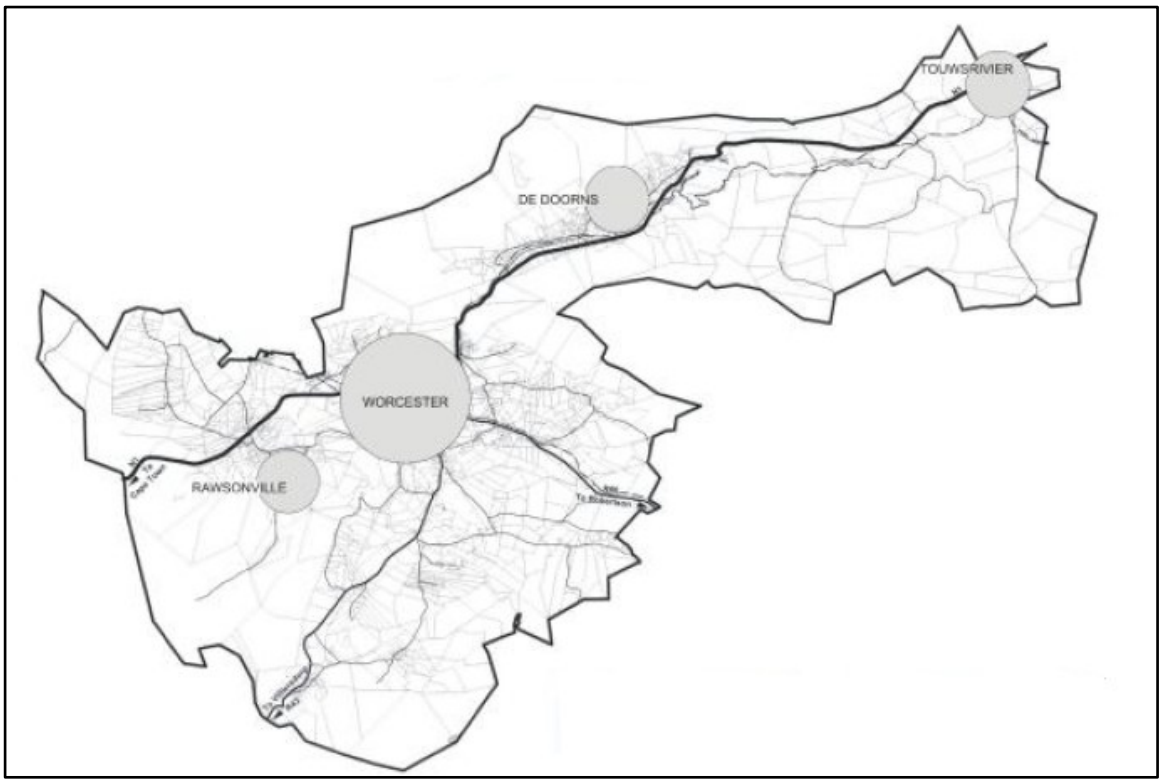


Figure 34 Breede Valley Municipal Area (113)

PARTICIPANT INFORMATION LEAFLET AND CONSENT FORM

TITLE OF THE RESEARCH PROJECT:

A community nutrition security research project in the Breede Valley, Western Cape Province, South Africa.

REFERENCE NUMBER:

PRINCIPAL INVESTIGATOR: Prof M.H. McLachlan

ADDRESS: Division of Human Nutrition

Room 3085

Clinical Building

Faculty of Health Sciences

Stellenbosch University

Tygerberg campus

CONTACT NUMBER: 021 938-9259

You are being invited to take part in a research project. Please take some time to read the information presented here, which will explain the details of this project. Please ask the study staff any questions about any part of this project that you do not fully understand. It is very important that you are fully satisfied that you clearly understand what this research entails and how you could be involved. Also, your participation is **entirely voluntary** and you are free to decline to participate. If you say no, this will not affect you negatively in any way whatsoever. You are also free to withdraw from the study at any point, even if you do agree to take part.

This study has been approved by the Health Research Ethics Committee (HREC) at Stellenbosch University **and will be conducted according to the ethical guidelines and principles of the international Declaration of Helsinki, South African Guidelines for Good Clinical Practice and the Medical Research Council (MRC) Ethical Guidelines for Research.**

What is this research study all about?

This research initiative forms part of a multidisciplinary research project conducted by the Division of Human Nutrition, Stellenbosch University. It is a baseline study that falls under the Stellenbosch University Food Security Initiative of which the Department of Industrial Engineering is a participant. These investigations will form the basis for further in-depth studies and a long term commitment for the design and implementation of community food security strategies that would contribute to the resilience of the local food system.

Why have you been invited to participate?

You have been chosen to participate in this study because you live in Avian Park and because you are a retail outlet owner/manager. We have used a way to choose addresses of outlets in Avian Park so that all outlets had the same chance of being chosen.

What will your responsibilities be?

We will ask you general questions about the outlet and specifically focus on food procurement strategies. Please answer honestly and clearly. We will fill in these question form at your outlet.

Will you benefit from taking part in this research?

You will benefit indirectly from participating in the study, because it will help us gather information regarding the local food system. This information will help us to work with leaders

and organizations in the communities to develop and implement plans to improve the food situation and therefore the nutritional status of the residents in this community. We will make a contribution to the local registered crèches in the community to thank you for your participation.

Who will have access to your personal records?

All information provided by you will be private. You will get a study number that will be placed on your completed question form. Nobody other than the researchers will see the individual, personal information. [To enable them to contact you if needed, only the researchers will be able to link your name to your answers and they will not share this information with anybody else.]

The results may however be used for publication in a scientific journal or for presentation at a scientific congress, without revealing your name.

Will you be paid to take part in this study and are there any costs involved?

Taking part in this study will not cost you anything. Also, the study researchers will not pay any fees to you to take part. We will, however, contribute to one / more of the local registered crèches in the communities.

Is there anything else that you should know or do?

You can phone Prof McLachlan or any of the researchers at tell 021 938-9259 if you have any further questions or if you have any problems.

You will receive a copy of this information and consent form for your own records.

Declaration by participant

By signing below, I ……..……. agree to take part in a research study with the title: A community nutrition security research project in the Breede Valley, Western Cape Province, South Africa.

I declare that:

I have read or had read to me this information and consent form and it is written in a language with which I am fluent and comfortable.

I have had a chance to ask questions and all my questions have been adequately answered.

I understand that taking part in this study is **voluntary** and I have not been pressurised to take part.

I may choose to leave the study at any time and will not be penalised or prejudiced in any way.

I may be asked to leave the study before it has finished, if the study doctor or researcher feels it is in my best interests, or if I do not follow the study plan, as agreed to.

Signed at (*place*) .....…..…….. on (*date*) ……...…….. 2011.

.....	.....
Signature of participant	Signature of witness

Appendix B: NAMC Market Basket

The food basket given below consists of the quantity (or volume) of foods that an average South African adult purchase for one month (45).

The Index (or national average prices) is based on the food prices given in the latest food price monitor report of August 2011. The National Agricultural Marketing Council (NAMC) reports the food price trends for different food items sold in urban and rural areas across South Africa. These prices are regarded as being representative of South African food retail prices. The food prices used by the NAMC are obtained from Statistics South Africa (Stats SA) and AC Nielsen.

Stats SA collects price data on all products from approximately 800 different collection points across South Africa every month. AC Nielsen also collects food price data on a monthly basis from approximately 1000 large food chain stores across the country. Prices for all the different food items are not always collected in all the provinces, but there are rigorous procedures in place to ensure the reliability of the data (135).

Table 18 Mean price of market basket by food retail outlet

Product	**Café**	**Small Supermarket**	***Spaza***	**Supermarket**	**Index**	**Vendor**	**Basket A**	**Basket B**	**Basket C**
Apples (1kg)	9.94	9.94	7.22	12.66	12.5	5.71	12.5	7.22	5.71
Banana (1kg)	15	10	8.86	7.99	9.96	9.44	9.96	8.86	7.99
Beans, dried (500g)	7.99	8.99	7.95	8.64	8.32		8.32	7.95	7.95
Beans, canned (410g)	7.6	7.9	8.19	6.88	8.46		8.46	7.6	6.88
Bread, white (700g)	7	7	7.42	7.06	8.9		8.9	7	7
Cabbage (1 head)	10	8	7.5	9.49	9.3	9	9.3	7.5	7.5

Cake Flour (2.5kg)	18.5	19	20.95	16.56	18.85		18.85	18.5	16.56
Chicken, pieces (1 kg)	26.83	28	30	22.5	22.29		22.29	28	22.5
Coffee (750g)	68	68	69	65.42	53.83		53.83	68	65.42
Eggs (1.5 dozen)	19.8	20.04	21.33	19	24.91		24.91	19.8	19
Maize meal (2.5kg)	16	15.99	16.82	14.99	17.72		17.72	15.99	14.99
Margarine (500g)	8.5	8.5	9.5	6.79	16.24		16.24	8.5	6.79
Milk, Long Life (1l)	10	9.99	9.9	8.94	9.68		9.68	9.99	8.94
Onions (1kg)	6.25	5	5.53	6.66	9.04	5.79	9.04	5	5
Orange (1kg)	4.63	4.63	3.77	5.49	5.88	2.71	5.88	3.77	2.71
Peanut Butter (410g)	16	15.99	16.5	14.98	16.82		16.82	15.99	14.98
Pilchards, canned (425g)	12.99	13	13.5	10.98	12.62		12.62	12.99	10.98
Potatoes (1kg)	6.25	4.77	4.77	7.24	9.36	4.7	9.36	4.77	4.7
Rice (2kg)	20	19.49	24	14.59	20.35		20.35	19.49	14.59
Samp (2.5kg)	7.05	7.2	8.4	5.56	14.14		14.14	7.05	5.56
Sugar (2.5kg)	25	24.99	24.99	22	20.79		20.79	24.99	22

Sunflower Oil (750ml)	12.99	13.99	13.33	11.54	15.76		15.76	12.99	11.54
Tea (62.5g)	7	6.5	8	4.91	7.32		7.32	6.5	4.91
Total	**343.32**	**336.91**	**347.43**	**310.87**	**353.04**	**37.36**	**353.04**	**328.45**	**294.21**

*Note that the missing values of items that the café and the small supermarket within the community did not sell were replaced by the mean of the food retail outlets carrying that item. This means that the mean price of an item in a community affects the price at all the outlets in that community. This may skew the results, but the number of missing items was less than 15%.

Appendix C: ANOVA Tests

The single factor ANOVA comparisons at the 0.1 significance level were conducted. The statistical tests were performed to determine whether or not the means of the food prices across the different food retail outlets (groups) are equal. The variances of the outcome are assumed to be equal across the groups.

The null hypothesis (H_0) for the 6 groups is that the population means (μ) (i.e. the unit price) of the outcome are the same for all the groups:

$$H_0 : \mu = \iota = ...\mu \qquad ....2$$

Spaza shop	Column 1
Supermarket	Column 2
Wholesaler	Column 3
Street Vendor	Column 4
Small supermarket in community	Column 5
Café in community	Column 6

Table 19 Numerical identification of the retail outlets

C1) Breads and cereals

Anova: Single Factor

SUMMARY

Groups	*Count*	*Sum*	*Average*	*Variance*
Column 1	73	0.9116	0.01248768	8.18E-05
Column 2	40	0.571436	0.01428591	0.000103
Column 3	9	0.106771	0.01186349	7.85E-05
Column 5	17	0.22023	0.01295468	8.17E-05
Column 6	14	0.142355	0.01016822	5.12E-05

ANOVA

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Groups	0.00020047	4	5.0117E-05	0.593098	0.668163	2.4327878
Within Groups	0.012506155	148	8.4501E-05			
Total	0.012706624	152				

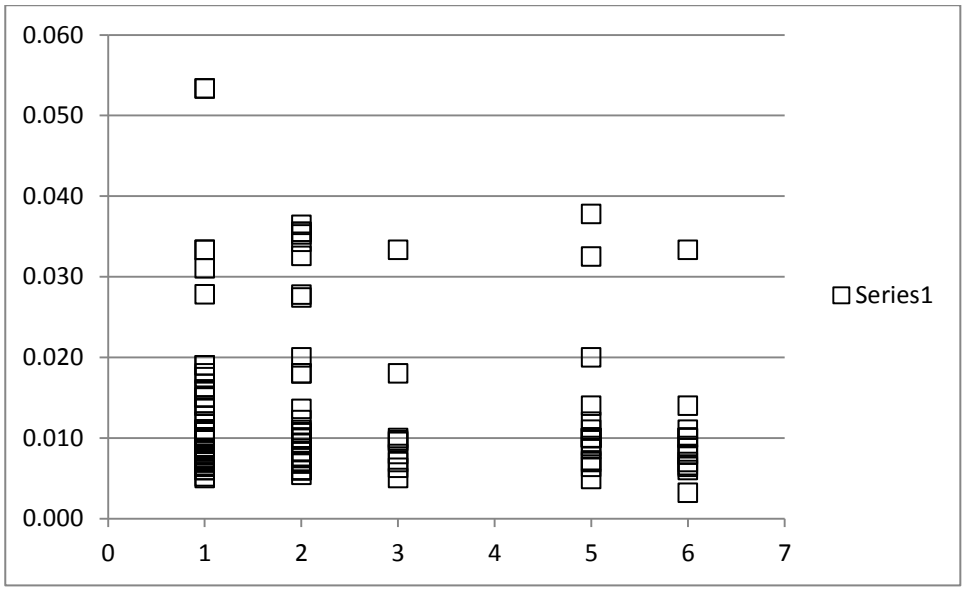


Figure 35 Distribution of unit prices for breads and cereals

The prices for breads and cereals is assumed not to vary significantly by store type ($F(4, 148) = 0.593$, $p>0.1$). The high p-value and visual inspection illustrates that there is no significant difference between the groups. The null hypothesis is accepted.

C2) Fats and oils

Anova: Single Factor

SUMMARY

Groups	*Count*	*Sum*	*Average*	*Variance*
Column 1	35	0.711667	0.020333	5.22E-05
Column 2	12	0.313129	0.026094	0.000165
Column 3	7	0.164428	0.02349	0.000126
Column 5	7	0.176202	0.025172	0.000135
Column 6	5	0.13075	0.02615	0.000244

ANOVA

Source of Variation	*SS*	*Df*	*MS*	*F*	*P-value*	*F crit*
Between Groups	0.000440857	4	0.00011	1.09544	0.366932	2.5226149
Within Groups	0.006137324	61	0.000101			
Total	0.006578181	65				

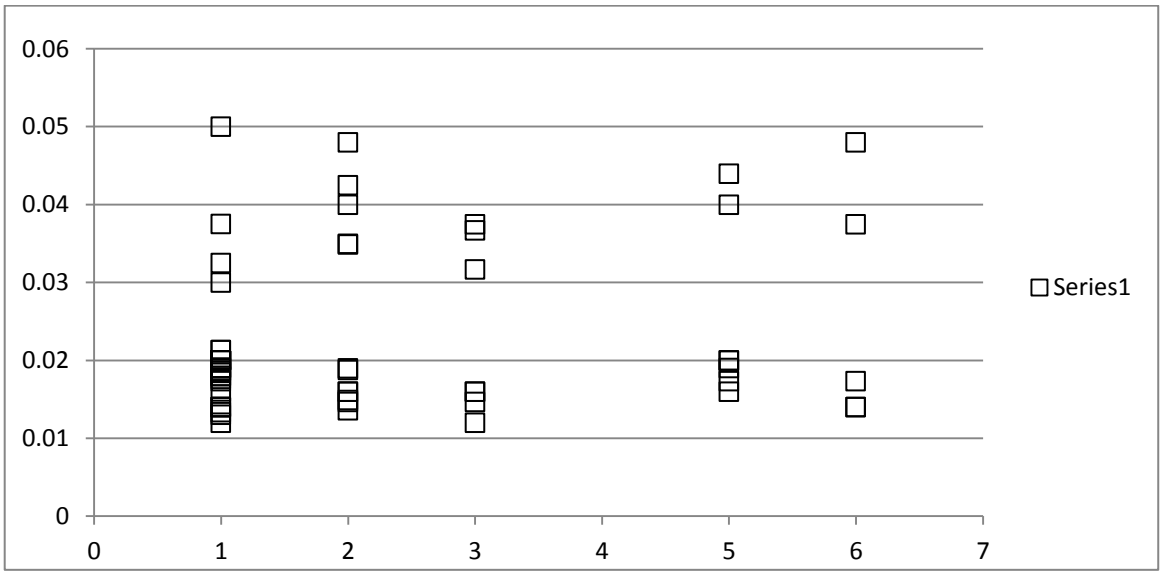


Figure 36 Distribution of unit prices for fats and oils

The prices for fats and oils is assumed not to vary significantly by store type ($F(4, 61) = 1.095$, $p>0.1$). The high p-value and visual inspection illustrates that there is no significant difference between the groups. The null hypothesis is accepted.

C3) Fresh fruit and vegetables

Anova: Single Factor

SUMMARY

Groups	*Count*	*Sum*	*Average*	*Variance*
Column 1	31	0.229008	0.007387	2.41E-05
Column 2	23	0.269617	0.011722	5E-05
Column 3	8	0.04965	0.006206	2.9E-05
Column 4	19	0.151963	0.007998	3.4E-05

ANOVA

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Groups	0.000322391	3	0.000107	3.136363	0.0301826	2.7233426
Within Groups	0.002638311	77	3.43E-05			
Total	0.002960702	80				

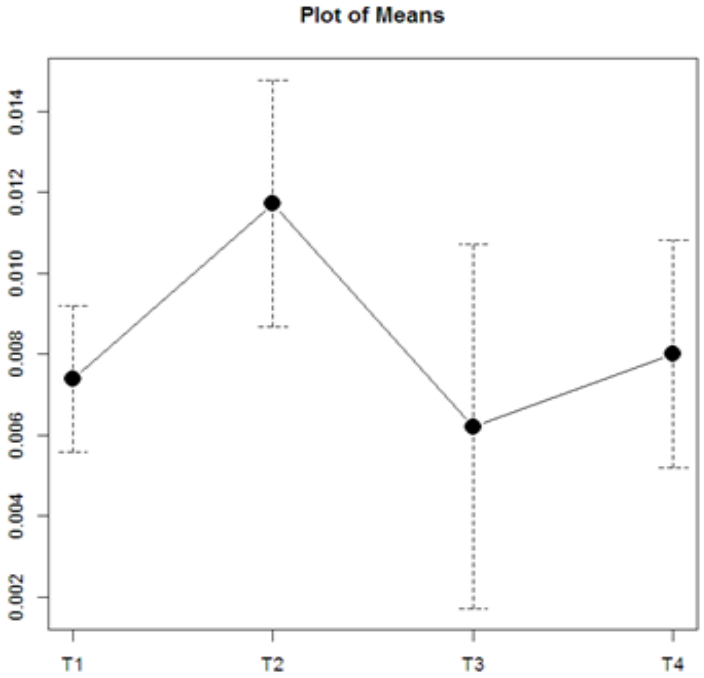


Figure 37 Plot of means for fruit and vegetables

The prices for fresh fruit and vegetables are assumed to vary significantly by store type ($F(3, 77) = 3.136$, $p<0,1$). The low p-value and visual inspection illustrates that there is a significant difference between the groups. The null hypothesis is rejected at a 90% confidence level.

C4) Meat and meat alternatives

Anova: Single Factor

SUMMARY

Groups	*Count*	*Sum*	*Average*	*Variance*
Column 1	81	2.422832	0.029912	0.0001767
Column 2	30	0.742061	0.024735	0.0001086
Column 3	11	0.196516	0.017865	4.544E-05
Column 5	9	0.216396	0.024044	8.061E-05
Column 6	8	0.183995	0.022999	6.751E-05

ANOVA

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Groups	0.001965	4	0.000491	3.4896093	0.00958	2.43925
Within Groups	0.018859	134	0.000141			
Total	0.020824	138				

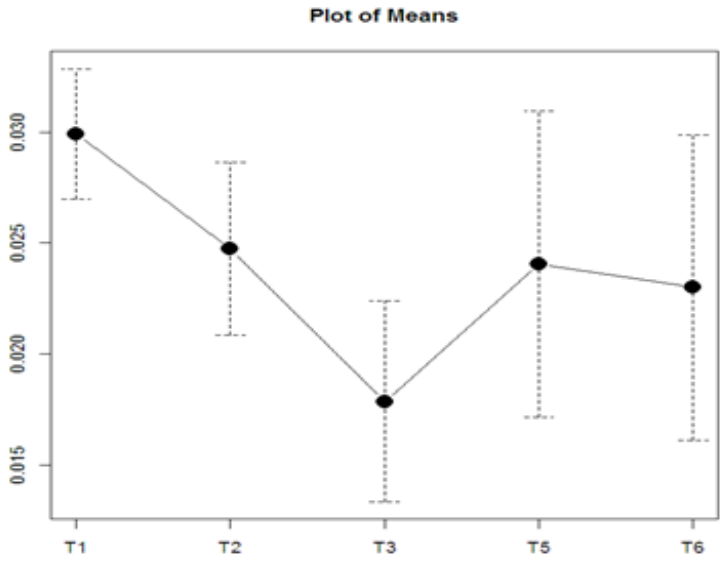


Figure 38 Plot of means for meat and meat alternatives

The prices for meat and meat alternatives are assumed to vary significantly by store type ($F(4, 134) = 3.490$, $p<0.1$). The low p-value and visual inspection illustrates that there is a significant difference between the groups. The null hypothesis is rejected at a 90% confidence level.

C5) Other

Anova: Single Factor

SUMMARY

Groups	*Count*	*Sum*	*Average*	*Variance*
Column 1	76	4.948063	0.065106	0.004772
Column 2	27	1.316953	0.048776	0.002094
Column 5	8	0.360905	0.045113	0.002509
Column 6	9	0.46006	0.051118	0.002712

ANOVA

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Groups	0.007758	3	0.002586	0.664248	0.575673	2.682809
Within Groups	0.451575	116	0.003893			
Total	0.459332	119				

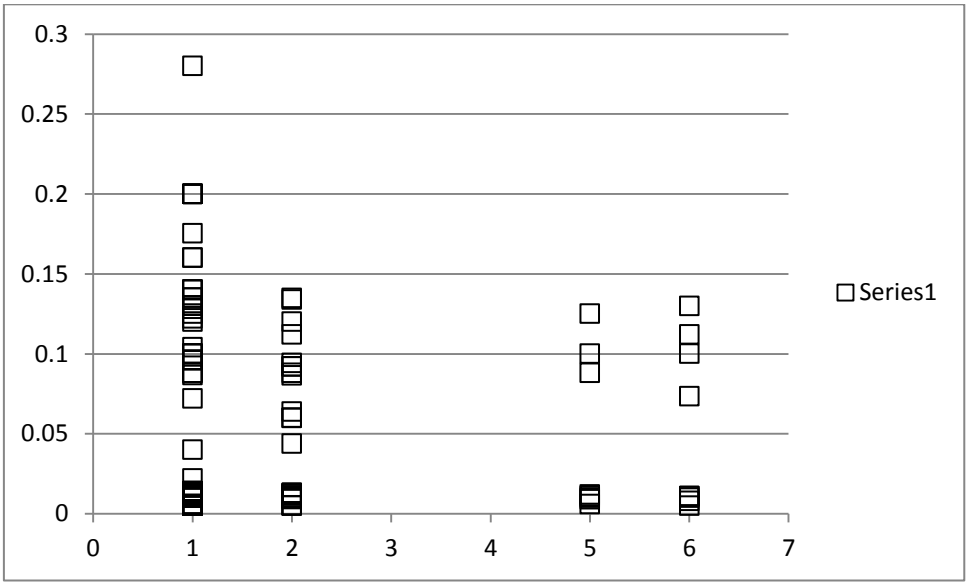


Figure 39 Distribution of unit prices for other food category

The prices for other food items are assumed not to vary significantly by store type ($F(3, 116) = 0.664$, $p>0.1$). The high p-value and visual inspection illustrates that there is no significant difference between the groups. The null hypothesis is accepted.

Appendix D: Characterisation of Avian Park's Food Retail Environment

ID	Type of Food Retail Outlet
1	*Spaza* Shop
2	*Spaza* Shop
3	*Spaza* Shop
4	*Spaza* Shop
5	*Spaza* Shop
6	*Spaza* Shop
7	*Spaza* Shop
8	*Spaza* Shop
9	*Spaza* Shop
10	*Spaza* Shop
11	*Spaza* Shop
12	*Spaza* Shop
13	*Spaza* Shop
14	Chain Supermarket
15	Chain Supermarket
16	Chain Supermarket
17	Street Vendor
18	Street Vendor
19	Street Vendor
20	Butcher
21	Butcher
22	Wholesaler
23	Wholesaler
24	Cafe in the community
25	Small supermarket in the community

D1) Profile of food retail outlet owners

ID	Owner/Manager (person completing survey)	Nationality (of owner)	Gender (of owner)	Age
1	M	Bangladeshi	M	25
2	O	South African	M	41
3	M	South African	M	47
4	O	South African	M	29
5	O	South African	M	23
6	O	Congolese	M	30
7	O	South African	M	29
8	O	Bangladeshi	M	25
9	O	South African	M	63
10	O	Bangladeshi	M	29
11	O	South African	F	42
12	M	Bangladeshi	M	38
13	M	Congolese	M	32
14	M	South African	M	49
15	M	South African	M	53
16	M	South African	M	32
17	O	South African	M	45
18	O	South African	F	41
19	O	South African	F	46
20	M	South African	M	54
21	M	South African	M	48
22	O	South African	F	41
23	M	South African	M	47
24	M	South African	M	36
25	O	South African	M	53

D2) Type of spaza shop accommodation

ID	Type
1	Shack
2	Inside a house
3	Brick building in back yard
4	Shack
5	Shack
6	Metal container
7	Shack
8	Shack
9	Room attached to main house
10	Shack
11	Metal Container
12	Shack
13	Metal Container

D3) Purchasing procedures of the Spaza Shops

ID	Supplier for fresh produce	Supplier for Other Products	Frequency of purchases (fresh)	Frequency of purchase (processed)	Method of transport	Delivery
1	Wholesaler	Wholesaler	2/week	1/week	Own vehicle	Bread, Cooldrink
2	Wholesaler	Wholesaler	3/week	1/week	Own vehicle	Bread, Cooldrink
3	Wholesaler/Farmer	Wholesaler	1/week	1/week	Own Vehichle	Bread, Cooldrink
4	Does not sell Fresh produce	Wholesaler/Supermarket	N/A	Daily	Taxi	No
5	Does not sell Fresh produce	Wholesaler/Supermarket	N/A	1/week	Friend's Vehichle	No
6	Wholesaler/Farmer	Wholesaler/Supermarket	1/week	2/week	Own Vehichle	No
7	Does not sell Fresh produce	Wholesaler	N/A	1/week	Taxi	No
8	Wholesaler	Wholesaler/Supermarket	2/week	Daily	Taxi	Bread, Cooldrink
9	Supermarket	Wholesaler/Supermarket	Only if on special	3/week	Own vehichle	No
10	Supermarket	Wholesaler	2/week	Daily	Taxi	Bread, Cooldrink
11	Supermarket	Wholesaler	1/week	2/week	Friend's vehichle	No
12	Wholesaler	Wholesaler/Supermarket	3/week	3/week	Taxi	Bread, Milk, Cooldrink
13	Does not sell fresh produce	Wholesaler		Daily	Taxi	No

D4) Product that is most frequently sold in Spaza shops

ID	Product
1	Bread, Cooldrink
2	Coffee, Cooldrink
3	Coffee, Sugar
4	Oil, Sugar
5	Cooldrink, Oil
6	Maize meal, Coffee
7	Maize meal, Cooldrink
8	Bread, Sugar
9	Bread, Cooldrink
10	Coffee, Tea
11	Cooldrink, Maize meal
12	Bread, Tea
13	Coffee, Cooldrink

D5) Local Food

ID	Sell local food	Supplier	Delivery	Obstacles	Buy Local if distribution centre	Need Delivery
1	No			Availability, storage capacity	Yes	Yes
2	No			Availability	Yes	Yes
3	No				Yes	Yes
4	No			Availability	Yes	Yes
5	No			Availability	Yes	Yes
6	Yes	Local Farm	Yes	Quality,	Yes	Yes

				storage capacity		
7	No			Availability, Storage capacity	Yes	Yes
8	No			Affordability, availability	Yes	Yes
9	No			Storage capacity	Yes	Yes
10	No			Affordability	Yes	Yes
11	Yes	Local Farm in De Doorns	No	Availability	Yes	Yes
12	No			Affordability	Yes	Yes
13	No			Availability, Storage capacity	Yes	Yes
14	No			Reveive produce from freshmarkets	No	N/A
15	No			Reveive produce from freshmarkets	No	N/A
16	No			Reveive produce from freshmarkets	No	N/A
17	No			Source produce from local wholesaler[26]	Yes	Yes

[26] The wholesaler source produce from areas outside of the Breede Valley Municipal (see following table in D6).

18	No			Source produce from local wholesaler	Yes	Yes
19	No			Source produce from local wholesaler	Yes	Yes
20	Yes	Chicken Farm in De Doorns	Yes		Yes	Yes
21	Yes	Chicken Farm in De Doorns	Yes		Yes	Yes
22	No			Availability	Yes	Yes
23	No			Availability	Yes	Yes
24	No			Availability, Affordability	Yes	Yes
25	No			Availability	Yes	Yes

D6) Type of supplier for fresh fruit and vegetable wholesaler

ID	Produce	Type	Deliver
22	Apples	Farm in Ceres	N
	Sweet Potato	Cape Town Market	N
	Carrot	Cape Town Market	N
	Beans	Cape Town Market	N
	Tomato	Cape Town Market	N
	Onion	Cape Town Market	N
	Cabbage	Farm in Wolseley	Y

Appendix E: System Dynamics Model

E1) Variables and their equations

Proportion of population with access to food

=IF THEN ELSE (food affordability>1,1*Population+proportion of population with access to retail outlets,food affordability*Population+proportion of population with access to retail outlets)

Proportion of population with access to retail outlets

=(probability to own vehicle+probability to use taxi)*Population

Food affordability

=expenditure on food/cost of food basket

if >1: food basket affordable

if <1: food basket unaffordable

Births

=Population*birth rate

Deaths

=death rate*Population

Expenditure on food

=per capita income*0.37

Food availability

=(food availability in cafe in community+food availability in small supermarket in community +food availability in spaza shops+local food production)/33

Food sufficiency

=(Population*food availability)/Population

if =1: food sufficient community

if <1: food insufficient community

Per capita income

=(monthly wages*employed population)/Population

Local food production

=insert constant here

Population

= INTEG (Births-Deaths,10000)

Employed population=Population*(1-0.21)

21% unemployment rate (11

Probability to use taxi

=IF THEN ELSE (per capita income<552, 0.2,0.6)

R552 considered to be the poverty line (118)

Probability to own vehicle

=IF THEN ELSE (per capita income<552,0.01,0.3)

E2) Model Validation

Validation 1

Initial time	2011
Final time	2020
Time step	0.0625

Validation 1 Inputs

	Death Rate
Baseline	0.01
Validation 1	0.5

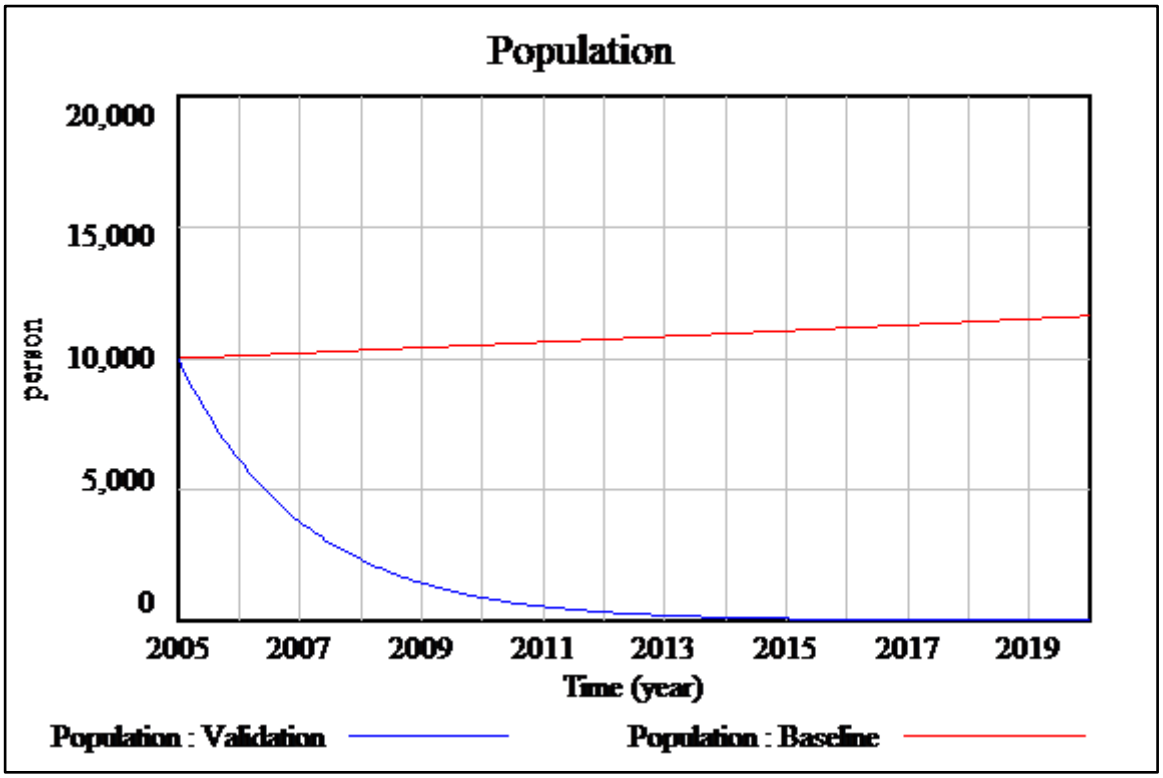


Figure 40 Validation 1 output graph

The population in reality would decrease drastically with an increased death rate

Validation 2

Validation 2 Inputs

	Monthly Wages
Baseline	893
Validation 2	2000

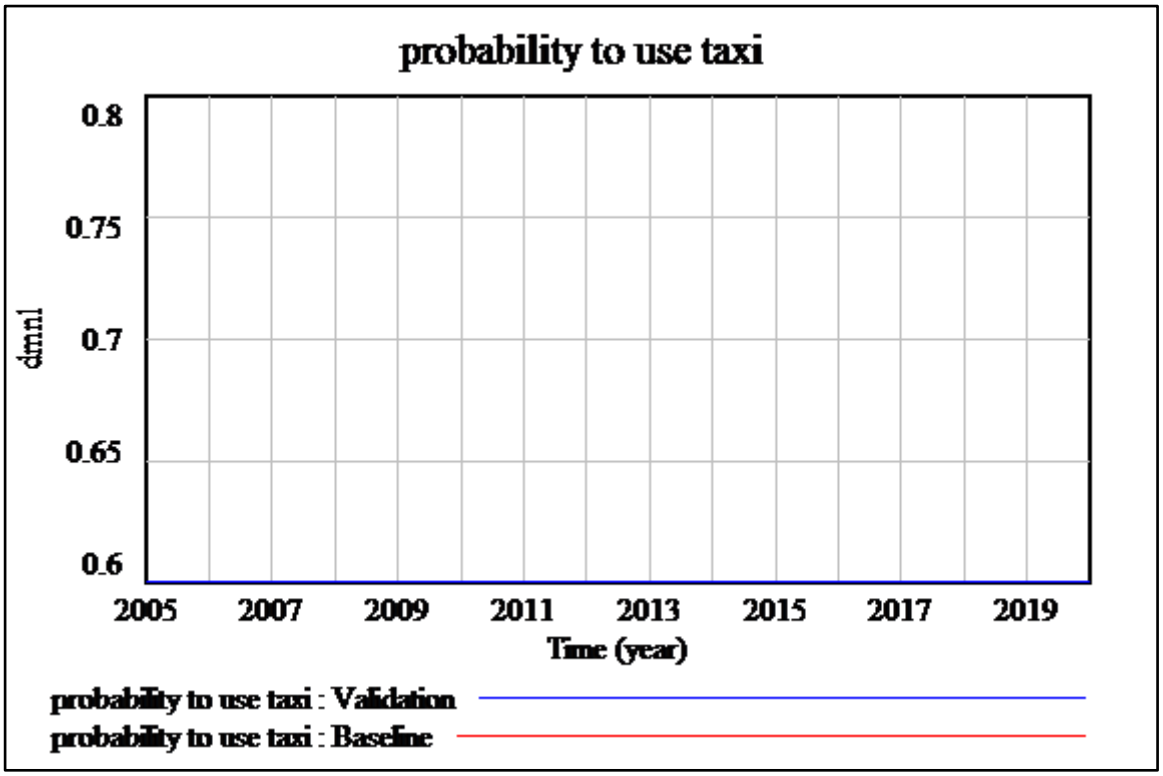


Figure 41 Validation 2 output graph

The probability to use taxi if the monthly wages are R2000 will be 0.6

Validation 3

Validation 3 Inputs

	Cost of food basket
Baseline	329
Scenario 1	500

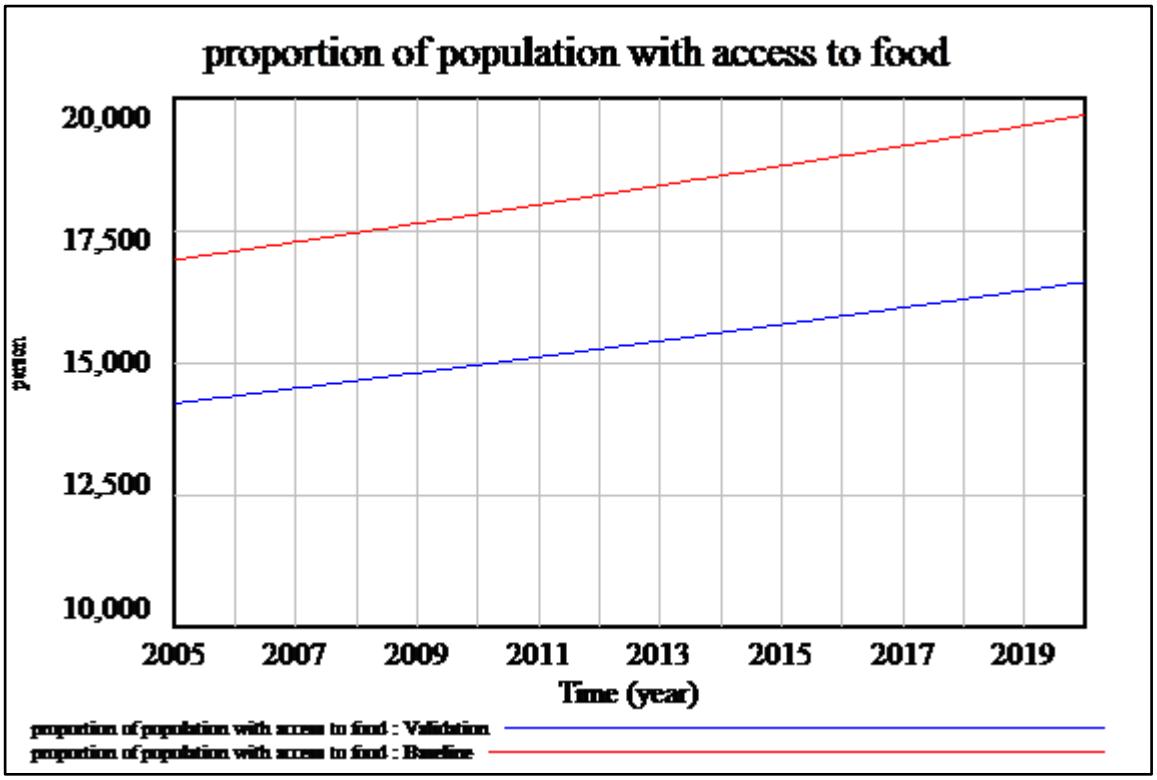


Figure 42 Validation 3 output graph

The proportion of the population with access to food will decrease if the cost of the basket of food increase.